

U.S. makes mi

By Frank Munger

News-Sentinel Oak Ridge bureau

OAK RIDGE — A legacy of Oak Ridge's Cold War work on nuclear weapons turned out to be a moneymaker in the late 1990s.

About 23 million pounds of lithium, stored at the government's K-25 Site since the late 1950s, was sold to industry bidders over the past couple of years, and the last drums of the material were removed from the Oak Ridge plant in

late January.

Jim Siberell, the project manager at Lockheed Martin, said revenues from the cleanup and removal activities, when combined with sales from a similar project at an Ohio plant — will return much as \$3 million to the U.S. Treasury.

"I think it's been a good success," Siberell said. "The project was executed without accident and injury-free, and we were able to establish some improved ways of removing and handling the material." The lithium hydroxide monohydrate

Pilot dies in plane crash near Hamilton County airport

COLLEGEDALE — The Federal Aviation Administration investigated the site Sunday where a small plane crashed in Hamilton County, killing the pilot.

Donnie Crook was trying to land his experimental plane Saturday night when the plane sheared a tree limb near a house. The plane struck pavement and careened through a 200-foot clearing before stopping short of the runway at the Collegedale Municipal Airport, just east of Chattanooga. It wasn't known what kind of a plane Crook was flying, but it was believed to have been experimental and worth about \$100,000. Crook reported losing power just before the crash.

Officer's cruiser vandalized outside his East Knox home

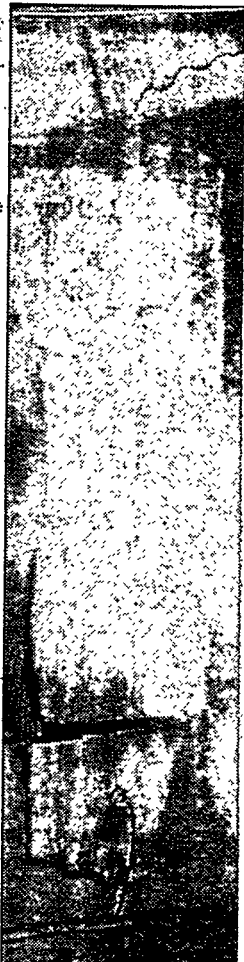
A Knoxville Police Department patrol officer's cruiser was vandalized while parked outside his East Knox County house overnight Friday, authorities said.

The cruiser was issued to Officer Phil Russell Sr. The windshield, rear window and a side window were smashed with what police suspect was a crowbar. His personal vehicle was not vandalized, nor were any other cars in the neighborhood.

The vandalism likely occurred sometime after midnight, but Russell did not discover the broken windows until Saturday morning when a retired KPD officer who lives in the same neighborhood saw it and reported it to the officer, according to police.

Authorities suspect the vandalism was a random act not connected to recent tension between the black community and KPD. Russell lives in a remote area. KPD spokesman Foster Arnett Jr.'s unmarked cruiser was spray-painted in January with references to a case that sparked tension between

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The Knoxville News-Sentinel

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was brought to Oak Ridge decades ago for use as feed material in a lithium-enrichment process. The resulting product was used in the manufacture of parts for thermonuclear weapons at the Oak Ridge Y-12 Plant.

Much of the lithium feed material was never used, however, and the fiberboard storage containers at K-25 (recently renamed the East Tennessee Technology Park) began to deteriorate and had to be repackaged in the mid-1980s.

About 55,000 drums were stored at

Oak Ridge, and three times that many were housed at the Department of Energy's plant in Portsmouth, Ohio. The lithium at the Ohio plant was the remnants from the enrichment process at Y-12.

After the leftover lithium was declared surplus, DOE undertook a decade-long process to identify possible users, take bids and prepare the tonnage for shipment. The Oak Ridge lithium, which had never been processed, was sold for about 18 cents a pound, while the material

stored in Portsmouth went for 13 cents a pound.

Lithium is used in the manufacturing of industrial chemicals and as an additive in construction materials, such as concrete.

The principal buyers were Cyprus Foote Co., based in North Carolina, and Toxco of California.

Now that the storage vaults at the Oak Ridge plant have been emptied, they will be prepared for other uses as part of DOE's "reindustrialization" program.

h Knox fire guts trailer



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1/17/97

pg. 1

Lithium

RFD (USEPA) = 2.00×10^{-2} mg/kg-d (=Max allowable daily dose)

Y-12 Plant Quarterly Reports:

- Li Usage • Lithium usage reported beginning ~ 1953
- Peak Li usage (LiOH) at Alpha-4 and Alpha-5 btwn 1955-1958 (~ 5 mill - 9 mill lbs/quarter total "feed" usage)
 - LiOH usage drops to ~ 4 mill lbs/quarter in 1959-1960 and ~ 2 mill lbs/quarter in 1961-1962
 - Beginning in 1963, production stopped

Li Water Monitoring

- Avg. Li concentration from daily water samples in EFPC (assumed to be at/near outfall) are reported for Oct. 1955 - Dec. 1959 → this corresponds with the period of peak Li usage
- Avg. EFPC water flows reported for same period
- Peak Li water conc. = 17 ppm in Oct. 1955 - Dec. 1955 (flow = 10.8 mill. gals/day)
- Water conc drop consistently to a low of 1.2 ppm in Oct. - Dec 1959

A

It can be assumed that 17 ppm Li = peak water conc. for the period of Li processing at Y-12 (1953-1962) because it was the highest ~~near~~ conc. measured in EFPC during the years of peak usage.

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Li Raw Materials Usage

Pg. 1 of 2

LiOH (monohydrate) (lbs)	LiCl (lbs)	Date	Rpt
32,175	300	4/1-6/30/53	Y-1002
422,824	—	10/1-12/31/53	Y-1004
780,050	—	1/1-3/31/54	Y-1005
828,875	57,441	4/1-6/30/54	Y-1006
?	?	7/1-9/30/54	Y-1007
?	?	10/1-12/31/54	Y-1008
?	?	1/1-3/31/55	Y-1009
?	?	4/1-6/30/55	Y-1010
Normal 2,979,442 (a-5) Normal 2,280,983 (a-4) Partially depleted 2,220,242 (a-4)	—	7/1-9/30/55	Y-1011
Normal 1,915,988 (a-5) Normal 2,483,690 (a-4) P.D. 1,208,130 (a-4)	—	10/1-12/31/55	Y-1012
Normal 2,160,972 (a-5) Normal 4,153,269 (a-4) P.D. 3,12,500 (a-4)	—	1/1-3/31/56	Y-1013
Normal 2,771,168 (a-5) Normal 5,976,005 (a-4) P.D. 0 (a-4)	—	4/1-6/30/56	Y-1014
Normal 2,831,372 (a-5) Normal 5,782,606 (a-4) P.D. 0 (a-4)	—	7/1-9/30/56	Y-1015
Normal 3,046,765 (a-5) Normal 5,687,212 (a-4) P.D. 0 (a-4)	—	10/1-12/31/56	Y-1016
Normal 2,910,297 (a-5) Normal 5,618,096 (a-4)	—	1/1-3/31/57	Y-1017
Normal 3,855,401 (a-5) Normal 5,682,600 (a-4)	—	4/1-6/30/57	Y-1018
Normal 3,029,333 (a-5) Normal 5,574,989 (a-4)	—	7/1-9/30/57	Y-1019
Normal 2,819,607 (a-5) Normal 5,361,016 (a-4)	—	10/1-12/31/57	Y-1020
Normal 2,733,919 (a-5) Normal 6,162,635 (a-4)	—	1/1-3/31/58	Y-1021
Normal 2,630,809 (a-5) Normal 5,476,172 (a-4)	—	4/1-6/30/58	Y-1201
Normal 2,614,250 (a-5) Normal 5,546,844 (a-4)	—	7/1-9/30/58	Y-1202
Normal 5,642,706 (a-5) Normal 3,462,889 (a-4)	—	10/1-12/31/58	Y-1203

Normal
Feed
Usage

Y-MA-190

Y/OZ-1078

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L: Raw Materials Usage

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L: OH (monohydrate) Δ_p

($\alpha - 4$) / b ₂	($\alpha - 5$) / b ₂	Date	Rpt
Normal 2,801,216	O	1/1 - 3/31/59	Y-1204
P.O. 583,100	475-normal	4/1 - 6/30/59	Y-1205
Normal 1,664,366		7/1 - 9/30/59	Y-1208
P.O. 2,790,011	393-normal	10/1 - 12/31/59	Y-1208
Normal 1,757,652		1/1 - 3/31/60	Y-1208
P.O. 2,901,406	O	4/1 - 6/30/60	Y-1210
Normal 1,741,214	O	7/1 - 9/30/60	Y-1210
P.O. 2,998,875	O	10/1 - 12/31/60	Y-1211
Normal 1,678,610	O	1/1 - 3/31/61	Y-1212
P.O. 2,869,585	O	4/1 - 6/30/61	Y-1214
Normal 1,459,548	O	7/1 - 9/30/61	Y-1214
P.O. 2,455,866	O	10/1 - 12/31/61	Y-1215
Normal 1,476,857	O	1/1 - 3/31/62	Y-1216
P.O. 2,454,431	O	4/1 - 6/30/62	Y-1217
Normal 1,465,309	O	7/1 - 9/30/62	Y-1218
P.O. 2,452,120	O	10/1 - 12/31/62	Y-1219
Normal 767,426	O	1/1 - 3/31/63	Y-1220
P.O. 1,294,857	O	4/1 - 6/30/63	Y-1421
Normal 655,340	O	7/1 - 9/30/63	Y-1422
P.O. 1,152,294	O	10/1 - 12/31/63	Y-1423
Normal 671,386	O	1/1 - 3/31/64	Y-1424
P.O. 1,179,647	O	4/1 - 6/30/64	Y-1425
Normal 673,173	O	7/1 - 9/30/64	Y-1426
P.O. 1,166,090	O	10/1 - 12/31/64	Y-1427
Normal 668,229	O	1/1 - 3/31/65	Y-1428
P.O. 1,147,777	O		
Normal 642,337	O		
P.O. 1,139,549	O		
Normal 632,656	O		
P.O. 1,130,247	O		
Normal 380,246	O		
P.O. 597,339	O		
Alpha-4	marble & process began		
went to standby in March	no gyps (wanted)		
not mentioned	marble having trouble		
	-no production		
	Marble & process began		
	Dependence 69,307		

4/15/97

Quarterly Rpt

Daily Water Samples from EFPC

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①

Year	Qt	Contaminant	Qt avg	Avg. Flow
1950	1 2 3 4			
1951	1 2 3 4			
1952	1 2 3 4			
1953	1 2 3 4	pu quartz (silica) pu quartz (silica) pu	27 μ /m/L 174.0 μ /m/L 141.0 μ /m/L	Y-1002 Y-1004 Y-1004
1954	1 2 3 4	quartz (silica) pu quartz (silica) pu NO NO	246.0 μ /m/L 226.3 μ /m/L	Y-1005 Y-1006 Y-1007 Y-1008
1955	1 2 3 4	NO NO NO		Y-1009 Y-1010 Y-1011
1956	1 2 3 4	Li Li Li Li	17 ppm 15 ppm 13 ppm 11 ppm	10.8 mill gals/day 11.7 mill gals/day 11.3 mill gals/day 10.8 mill gals/day
1957	1 2 3 4	Li Li Li Li	7.6 ppm 5.5 ppm 4.8 ppm (change per Y-1020) 3.5 ppm	9.1 mill gals/day 13.2 mill gals/day 10.6 mill gals/day 9.5 mill gals/day
1958	1 2 3 4	Li Li Li Li	4.4 ppm 3.2 ppm 2.8 ppm 5.4 ppm	10.8 mill gals/day 9.6 mill gals/day 9.4 mill gals/day 8.3 mill gals/day
1959	1 2 3 4	Li Li Li Li	6.0 ppm 2.7 ppm 1.9 ppm 1.2 ppm	7.8 mill gals/day 8.4 mill gals/day 9.7 mill gals/day 9.4 mill gals/day
1960	1 2 3 4	ND ND ND ND		10.5 mill gals/day Y-1208 Y-1209 Y-1210
1961	1 2 3 4	ND ND ND ND	Not given	Y-1211
1962	1 2 3 4	ND ND ND ND		Y-1212 Y-1213 Y-1214 Y-1215 Y-1216 Y-1217 Y-1218 Y-1219

Daily sample (Avg)

Quarterly Rpt.

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1/15/97

②

Daily Water Samples from EFPC				pg. 2 of 2
Year	Qt	Contaminant	Collected Qt. Avg.	Avg. Flow
1964	1	ND		Y-1420
	2	collected, results not given (ND)		Y-1425
	3	ND		Y-1426
	4	ND		Y-1427
1965	1	ND		Y-1428
	2			
	3			
	4			
1966	1			Y-1513
	2	collected, results not given (only)		Y-1513
	3			
	4			
1967	1			Y-1517
	2	collected, results not given (only)		Y-1517
	3			
	4			
1968	1			Y-1631
	2	collected, not given		Y-1631
	3			
	4			
1969	1			Y-1635
	2	collected, not given		Y-1635
	3			
	4			
1970	1			Y-1639
	2	collected, not given		Y-1639
	3			
	4			

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4/17/97

Pg. 2

Li Screening Calc. for Water (Ingestion):

Level I Dose =
$$\frac{\text{Water conc (mg/L)} \times \text{Ing. rate (L/d)} \times \text{Fraction absorbed} \times \text{EF} \times \text{ED (yr)}}{\text{BW (kg)} \times \text{AT (d)}}$$

$$= \frac{17 \text{ mg/L} \times 2.2 \text{ L/d} \times 0.5 \times 365 \text{ d/yr} \times 1 \text{ yr}}{70 \text{ kg} \times 365 \text{ d}} = 0.27 \text{ mg/kg-d}$$

$$\text{HI} = \frac{\text{Dose}}{\text{RfD}} = \frac{0.27 \text{ mg/kg-d}}{\frac{0.02 \text{ mg/kg-d}}{4}} = \boxed{13.5} \quad 0.07$$

Level II Dose =
$$\frac{17 \text{ mg/L} \times 1.4 \text{ L/d} \times 0.2 \times 365 \text{ d/yr} \times 1 \text{ yr}}{70 \text{ kg} \times 365 \text{ d}} = 0.068 \text{ mg/kg-d}$$

$$\text{HI} = \frac{0.068 \text{ mg/kg-d}}{\frac{0.02 \text{ mg/kg-d}}{4}} = \boxed{3.4} \quad 0.02$$

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4/17/97

p.3

L: Air Releases:

change to T-6

SCREEN model

- Based on a unit emission rate of 1 g/s, model predicts a max one-hour air conc. of $326.0 \mu\text{g}/\text{m}^3$ at the closest receptor location (1 mile = 1600 m away), under worst-case met conditions
- To get an annual avg. from the max 1 hr, multiply annual avg. air conc. by 0.1 (CARB, 1987)
- \therefore Annual avg. air conc at 1 mile from source = $32.6 \mu\text{g}/\text{m}^3$

$$\frac{1 \text{ g}}{\text{s}} \times \frac{\text{kg}}{1000 \text{ g}} \times \frac{60 \text{ s}}{\text{min}} \times \frac{60 \text{ min}}{\text{hr}} \times \frac{24 \text{ hr}}{\text{d}} \times \frac{365 \text{ d}}{\text{yr}} = 31,536 \text{ kg/yr}$$

$$= 69,525 \text{ lb/yr}$$

$$\begin{aligned} & \text{(1 g/s)} = 0.0326 \text{ ng}/\text{m}^3 \\ \therefore 69,525 \text{ lb/yr (emission rate)} &= 32.6 \mu\text{g}/\text{m}^3 \text{ (air conc. at 1 mile)} \end{aligned}$$

$$\text{L: RfD} = \text{Max. allowable daily dose} = \frac{200 \times 10^{-2} \text{ mg/kg-d}}{14} \text{ (EPA)}$$

$$\text{Max allowable daily dose (mg/kg-d)} = \frac{\text{Max allowable air conc (ng}/\text{m}^3) \times \text{Inhal rate (m}^3/\text{d)}}{\text{BW (kg)}}$$

$$\text{Max allowable air conc (ng}/\text{m}^3) = \frac{200 \times 10^{-2} \text{ mg/kg-d} \times 70 \text{ kg}}{20 \text{ m}^3/\text{day}} = \frac{0.07}{14} \text{ mg}/\text{m}^3$$

$$\frac{\text{Max allowable Emission Rate (lb/yr)}}{\text{Max allowable air conc (ng}/\text{m}^3)} = \frac{69,525 \text{ lb/yr}}{0.0326 \text{ ng}/\text{m}^3}$$

$$\text{Max. Allowable Emission Rate} = \boxed{149,000 \text{ lb/yr}}$$

$$2,986,000$$

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Li Fabrication Ops

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7-15-97

Richard
Boyle
4-1766
Classification
Office

aqueous to this pt
crystallization - dust
respirators - ^{WZO} "bird bath" ^{crystallizer} 5-6 yrs. ago,
metal cells - ^{face} dust vs. keep dust low changed to closed system
rectifier closed operation
open hood for reactor removal - ^{probably} filtered dust
knockout op. sledgehammer to break chunks and ~~the~~ recovered
 β -2 only bldg. (β -4 pilot) v. early

grinding - enclosed - dry box

blender \rightarrow mold loader - maybe dust here 10 yrs ago
surface ~~no~~ dust after pressing wet \rightarrow closed system

machining - closed dry box dust collected
can put dust back into system - stored as ⁶Li Cl
dry rooms to protect from moisture (body)

also contact: Don Merkel

4-2477

Bldg. 9204-2

paper 417-5616



Roxane Laboratories—Cont.

to parathyroid extract, Dihydratichysterol is active when taken orally, exerts a slow but persistent effect, and may be used for long periods without increasing the dosage or causing tolerance. Dihydratichysterol is faster-acting than pharmacologic doses of vitamin D and is less persistent after cessation of treatment, thus decreasing the risk of accumulation and of hypercalcemia.

INDICATIONS AND USAGE

Dihydratichysterol is indicated for the treatment of acute, chronic, and latent forms of postoperative tetany, idiopathic tetany, and hypoparathyroidism.

CONTRAINDICATIONS

Contraindicated in patients with hypercalcemia, abnormal sensitivity to the effects of vitamin D, and hypervitaminosis D.

PRECAUTIONS

General: The difference between therapeutic dose and intoxicating dose may be small in any patient and therefore dosage must be individualized and periodically reevaluated. In patients with renal osteodystrophy accompanied by hyperphosphatemia, maintenance of a normal serum phosphorus level by dietary phosphate restriction and/or administration of aluminum gels as intestinal phosphate binders is essential to prevent metastatic calcification.

Because of its effect on serum calcium, Dihydratichysterol should be administered to pregnant patients or to patients with renal stones only when, in the judgment of the physician, the potential benefits outweigh the possible hazards. **Laboratory tests:** To prevent hypercalcemia, treatment should always be controlled by regular determinations of blood calcium level, which should be maintained within the normal range.

Drug interactions: Administration of thiazide diuretics to hypoparathyroid patients who are concurrently being treated with Dihydratichysterol may cause hypercalcemia.

Pregnancy: Teratogenic effects—Pregnancy Category C: Animal reproduction studies have shown fetal abnormalities in several species associated with hypervitaminosis D. These are similar to the supravalvular aortic stenosis syndrome described in infants by Black in England (1963). This syndrome was characterized by supravalvular aortic stenosis, elfin facies, and mental retardation.

There are no adequate and well-controlled studies in pregnant women. Dihydratichysterol should be used during pregnancy only if the potential benefit justifies the potential risk to the fetus.

Nursing mothers: It is not known whether this drug is excreted in human milk. Because many drugs are excreted in human milk, caution should be exercised when Dihydratichysterol is administered to a nursing woman.

OVERDOSAGE

The effects of Dihydratichysterol can persist for up to one month after cessation of treatment.

Manifestations: Toxicity associated with Dihydratichysterol is similar to that seen with large doses of vitamin D. Overdosage is manifested by symptoms of hypercalcemia, i.e., weakness, headache, anorexia, nausea, vomiting, abdominal cramps, diarrhea, constipation, vertigo, tinnitus, ataxia, hypotonia, lethargy, depression, amnesia, disorientation, hallucinations, syncope, and coma. Impairment of renal function may result in polyuria, polydipsia, and albuminuria. Widespread calcification of soft tissues, including heart, blood vessels, kidneys, and lungs, can occur. Death can result from cardiovascular or renal failure.

Treatment: Treatment of overdosage consists of withdrawal of Dihydratichysterol, bed rest, liberal intake of fluids, a low-calcium diet, and administration of a laxative. Hypercalcemic crisis with dehydration, stupor, coma, and azotemia requires more vigorous treatment. The first step should be hydration of the patient. Intravenous saline may quickly and significantly increase urinary calcium excretion. A loop diuretic (furosemide or ethacrynic acid) may be given with the saline infusion to further increase renal calcium excretion. Other reported therapeutic measures include dialysis or the administration of citrates, sulfates, phosphates, corticosteroids, EDTA (ethylenediaminetetraacetic acids), and mithramycin via appropriate regimens.

DOSAGE AND ADMINISTRATION

The dosage depends on the nature and seriousness of the disorder and should be adapted to each individual patient. Serum calcium levels should be maintained between 9 to 10 mg per 100 mL.

The following dosage schedule will serve as a guide:

Initial dose: 0.8 mg to 2.4 mg daily for several days.

Maintenance dose: 0.2 mg to 1.0 mg daily as required for normal serum calcium levels. The average maintenance dose is 0.6 mg daily. This dose may be supplemented with 10 to 15 grams of calcium lactate or gluconate by mouth daily.

HOW SUPPLIED

0.125 mg white tablets.

NDC 0054-8172-25: Unit dose, 10 tablets per strip, 10 strips per shelf pack, 10 shelf packs per shipper.

NDC 0054-4190-19: Bottles of 50 tablets.

0.2 mg pink tablets.

NDC 0054-8182-25: Unit dose, 10 tablets per strip, 10 strips per shelf pack, 10 shelf packs per shipper.

NDC 0054-4189-25: Bottles of 100 tablets.

0.4 mg white tablets.

NDC 0054-4191-19: Bottles of 50 tablets.

Intensol 0.2 mg/mL

NDC 0054-3170-44: Bottles of 30 mL with calibrated dropper (graduated 0.25 mL to 1.0 mL)

LITHIUM CARBONATE

CAPSULES USP 150 mg, 300 mg, and 600 mg

TABLETS USP 300 mg

WARNING

Lithium toxicity is closely related to serum lithium levels, and can occur at doses close to therapeutic levels. Facilities for prompt and accurate serum lithium determinations should be available before initiating therapy.

DESCRIPTION

Each tablet for oral administration contains:

Lithium Carbonate 300 mg

Each capsule for oral administration contains:

Lithium Carbonate 150 mg, 300 mg, or 600 mg

Inactive Ingredients:

The capsules contain talc, gelatin, FD&C Red No. 40, titanium dioxide, and the imprinting ink contains FD&C Blue No. 2, FD&C Yellow No. 6, FD&C Red No. 40, synthetic black iron oxide, and pharmaceutical glaze. The tablets contain calcium stearate, microcrystalline cellulose, povidone, sodium lauryl sulfate, and sodium starch glycolate.

Lithium Carbonate is a white, light alkaline powder with molecular formula Li_2CO_3 and molecular weight 73.89. Lithium is an element of the alkali-metal group with atomic number 3, atomic weight 6.94 and an emission line at 671 nm on the flame photometer. Lithium acts as an antimanic.

CLINICAL PHARMACOLOGY

Preclinical studies have shown that lithium alters sodium transport in nerve and muscle cells and effects a shift toward intraneuronal metabolism of catecholamines, but the specific biochemical mechanism of lithium action in mania is unknown.

INDICATIONS AND USAGE

Lithium carbonate is indicated in the treatment of manic episodes of Bipolar Disorder. Bipolar Disorder, Manic (DSM-III) is equivalent to Manic Depressive illness, Manic, in the older DSM-II terminology.

Lithium is also indicated as a maintenance treatment for individuals with a diagnosis of Bipolar Disorder. Maintenance therapy reduces the frequency of manic episodes and diminishes the intensity of those episodes which may occur. Typical symptoms of mania include pressure of speech, motor hyperactivity, reduced need for sleep, flight of ideas, grandiosity, or poor judgment, aggressiveness, and possibly hostility. When given to a patient experiencing a manic episode, lithium may produce a normalization of symptomatology within 1 to 3 weeks.

CONTRAINDICATIONS

Lithium should generally not be given to patients with significant renal or cardiovascular disease, severe debilitation or dehydration, or sodium depletion, and to patients receiving diuretics, since the risk of lithium toxicity is very high in such patients. If the psychiatric indication is life-threatening, and if such a patient fails to respond to other measures, lithium treatment may be undertaken with extreme caution, including daily serum lithium determinations and adjustment to the usually low doses ordinarily tolerated by these individuals. In such instances, hospitalization is a necessity.

WARNINGS

Lithium may cause fetal harm when administered to a pregnant woman. There have been reports of lithium having adverse effects on nidation in rats, embryo viability in mice, and metabolism in-vitro of rat testis and human spermatozoa have been attributed to lithium, as have teratogenicity in submammalian species and cleft palates in mice. Studies in rats, rabbits and monkeys have shown no evidence of lithium-induced teratology. Data from lithium birth registries suggest an increase in cardiac and other anomalies, especially Ebstein's anomaly. If the patient becomes pregnant while taking lithium, she should be apprised of the potential risk to the fetus. If possible, lithium should be withdrawn for at least the first trimester unless it is determined that this would seriously endanger the mother.

Chronic lithium therapy may be associated with impairment of renal concentrating ability, occasionally resulting in nephrogenic diabetes insipidus, with polyuria and polydipsia. Such patients should be carefully managed to maintain hydration with resulting lithium retention and toxicity. This condition is usually reversible when lithium is discontinued. Morphologic changes with glomerular and interstitial nephritis and nephron-atrophy have been reported in patients on chronic lithium therapy. Morphologic changes have been seen in bipolar patients never exposed to lithium. The relationship between renal functional and morphologic changes and their association with lithium therapy has not been established. To date, lithium in therapeutic doses has not been reported to cause end-stage renal disease.

When kidney function is assessed, for baseline data and during starting lithium therapy or thereafter, routine water deprivation, or 24-hour urine volume) and creatinine clearance (e.g., urine specific gravity or osmolality following a water deprivation, or 24-hour urine volume) and creatinine clearance (e.g., serum creatinine or creatinine clearance) should be performed. During lithium therapy, progressive or sudden changes in renal function, even within the normal range, indicate a need for reevaluation of treatment.

Lithium toxicity is closely related to serum lithium levels and can occur at doses close to therapeutic levels. Facilities for prompt and accurate serum lithium determinations should be available before initiating therapy.

PRECAUTIONS

General: The ability to tolerate lithium is greater in the acute manic phase and decreases when mania subsides (See DOSAGE AND ADMINISTRATION). The distribution space of lithium approximates that of body water. Lithium is primarily excreted in urine with a significant excretion in feces. Renal excretion of lithium is proportional to its plasma concentration. The half-life of elimination of lithium is approximately 24 hours. Lithium decreases sodium reabsorption by the renal tubule and could lead to sodium depletion. Therefore, it is essential for the patient to maintain a normal diet, including adequate fluid intake (2500-3000 mL) at least during the initial stabilization period. Decreased tolerance to heat has been reported to ensue from protracted sweating and dehydration, and if such occur, supplemental fluid and salt should be administered.

In addition to sweating and diarrhea, concomitant with elevated temperatures may also necessitate a temporary reduction or cessation of medication. Previously existing underlying thyroid disorders do not necessarily constitute a contraindication to lithium therapy where hypothyroidism exists, careful monitoring of thyroid function during lithium stabilization and maintenance therapy for correction of changing thyroid parameters is essential. Where hypothyroidism occurs during lithium therapy, and maintenance, supplemental thyroid treatment should be used.

Information for the patients: Outpatients and their families should be warned that the patient must discontinue lithium therapy and contact his physician if such clinical signs as lithium toxicity as diarrhea, vomiting, tremor, muscle weakness, drowsiness, or muscular weakness occur.

Lithium may impair mental and/or physical abilities of operating patients about activities requiring alertness and/or operating vehicles or machinery.

Drug interactions: Combined use of haloperidol and lithium may cause an encephalopathic syndrome (characterized by lethargy, fever, tremulousness and confusion, extrapyramidal symptoms, leucocytosis, elevated serum creatinine and BUN) followed by irreversible brain damage. This syndrome has been reported in a few patients treated with lithium plus haloperidol. A causal relationship between these events and the combination administration of lithium and haloperidol has not been established; however, patients receiving such combination therapy should be monitored closely for early evidence of neurological toxicity and treatment discontinued promptly if signs appear.

The possibility of similar adverse interactions with other antipsychotic medication exists. Lithium may prolong the effects of neuromuscular blocking agents. Therefore, neuromuscular blocking agents should be given with caution to patients receiving lithium. Indomethacin and piroxicam have been reported to significantly steady state plasma lithium levels. In cases lithium toxicity has resulted from such combination. There is also evidence that other non-steroidal anti-inflammatory agents may have a similar effect. When such combinations are used, increased plasma lithium levels are recommended.

Caution should be used when lithium and diuretics are used together because sodium loss may reduce the renal excretion of lithium and increase serum lithium levels with resultant lithium toxicity. When such combinations are used, the dosage may need to be decreased, and more frequent monitoring of lithium plasma levels is recommended. **Pregnancy: Teratogenic effects—Pregnancy Category C:** "Warnings" section.

Lithium H2O Losses

DATE	KGS	LBS	AVG			AVG		
	Bldg A-5	Bldg A-5	lbs/mo			kg/mo	kg/day	kg/day
Apr-57	1855.00	4081.00					Bldg A-5	Bldg A-5&A-4
May-57	2526.81	5558.98						
Jun-57	2280.64	5017.41						
Jul-57	1598.25	3516.15	2868.84	JUL,AUG,SEPT				
Aug-57	1471.39	3237.06						
Sep-57	842.41	1853.30						
Oct-57	863.03	1898.67						
Nov-57	811.47	1785.23						
Dec-57	850.27	1870.59						
Jan-58	1472.38	3239.24	2314.02	AUG - JAN		1051.83	33.93	101.6
Feb-58	1031.71	2269.76						
Mar-58	793.35	1745.37						
Apr-58	414.90	912.78						
May-58	341.81	751.98						
Jun-58	500.60	1101.32						
Jul-58	531.11	1168.44						
Aug-58	471.81	1037.98						
Sep-58	622.23	1368.91						
Oct-58	549.67	1209.27						
Nov-58	844.97	1858.93						
Dec-58	1411.95	3106.29						
Jan-59	2542.48	5593.46						
Feb-59	803.26	1767.17						
Mar-59	997.99	2195.58	2422.70	1957-59				
Apr-59								

Alloy and Solvent Loss Study for Alpha-5

The purpose of this study is to determine the origin of loss of ^(Li)alloy and ^(Hg)solvent in Alpha-5. Suggestions and steps taken to minimize these losses are also included.

The cascade waste system is composed of six sump tanks (No. 1, 2, 3, 4, 5, 6) located in Fan Rooms C, D, E, F, G, and H, and four waste tanks (No. F-451, F-452, F-1451, and F-1452) located on the first floor. The fan room sump tanks collect the building effluent from the first floor, extract area, feed prep area and pump washing area in the maintenance shop. The waste tanks (F-451, F-452, F-1451, F-1452) which are located on first floor collect the building effluent from the cascade working areas on the second, third, and fourth floors and the equipment wash sinks in the maintenance shop. The sumps and waste tanks continuously trap out solvent which is returned to the system while the waste aqueous is pumped to a central sump (No. F-1150) which in turn allows any entrained solvent to further settle out. The effluent rate at this point determines the settling time. The aqueous from F-1150 is then disposed of in a creek located on the south side of the Y-12 area.

The building effluent is composed of material that collects in the sump tanks and the waste tanks from the following points of entry: Cascade and absorber room floor drains, two MG breaker room floor drains, cascade seal pots, feed prep floor drains and decomposers, extract area evaporators, laboratory test tables, tool and equipment wash sinks, pump wash area, solvent wash systems, solvent hold tank overflow, Buffalo pump solvent tub overflow, Moyno pump packing drip pans, office air conditioning unit condensate drain, vacuum system entrainment separators, chemical recovery area, and feed storage area.

Samples are taken from each sump, (No. 1, 2, 3, 4, 5, 6), and waste tank (F-451, F-452, F-1451, F-1452) twice each shift. These samples are composited for a

period of 24 hours and then titrated to determine alloy concentration. The effluent pumped from each pump is determined by the number of hours the pump of rated gpm operated in a twenty-four hour period. From this data a loss figure is determined for each sump and waste tank. Samples are also taken hourly at the central sump, F-1150, and composited for a twenty-four hour period. The volume of effluent pumped from the sump to the creek is determined by pump capacity curves and the running time of the sump pumps for a period of twenty-four hours.

Sump F-1150 also collects effluent from the mixing tubs in the Alpha-5 demineralizer area and condensate from the Alpha-5 evaporator emergency condensate overflow. However, it is very seldom that the demineralizer or the evaporators at Alpha-5 are operated so it is reasonably safe to assume that the alloy and solvent loss in sump F-1150 is completely from the Alpha-5 process.

The sump alloy and solvent losses for the months of July, August, and September are as follows:

July: 1951

<u>Sump or Tank No.</u>	<u>Gallons Effluent Pumped</u>	<u>Kgs. Alloy Lost</u>	<u>Atom %</u>	<u>Solvent Loss - lbs.</u>
1	243,270	524		
2	261,280	70		
3	21,600	10		
4	70,350	22		
5	546,840	51		
6	1,234,200	60		
F-451, F-452	4,562,308	659		
F-1451, F-1452	<u>4,681,320</u>	<u>361</u>		
Total	11,319,168	2,357		
F-1150	9,609,800	1,598	9.39	1,367

August: 1951

<u>Sump or Tank No.</u>	<u>Gallons Effluent Pumped</u>	<u>Kgs. Alloy Lost</u>	<u>Atom %</u>	<u>Solvent Loss - lbs.</u>
1	324,150	972		
2	405,960	62		
3	17,280	17		
4	0	0		
5	477,780	62		
6	433,303	3		
F-451, F-452	4,946,526	344		
F-1451, F-1452	<u>3,013,156</u>	<u>266</u>		
Total	9,618,160	2,051		
F-1150	6,534,510	1,471	8.14	974

September: 1951

1	505,620	397		
2	479,400	118		
3	24,480	76		
4	0	0		
5	157,500	64		
6	437,250	6		
F-451, F-452	3,293,153	384		
F-1451, F-1452	<u>3,752,286</u>	<u>480</u>		
Total	3,649,689	1,526		
F-1150	5,581,770	342	8.63	916

It should be noted the reduction in both alloy and solvent losses for the above shown periods is because a concentrated effort is being made to materially reduce such losses.

Sump F-1150 losses should be equal to the total of the sump and waste tank losses, but due to the sampling procedures and method of measuring flow rate, the loss figures differ. The loss determined at central sump F-1150 is more accurate because: (a) A concentration is determined for sump F-1150 from a composite that is made up of samples taken each hour for a twenty-four (24) hour period; whereas, a concentration determined for each sump is from a composite of samples taken only twice a shift for twenty-four (24) hours. (b) Flow rate data and concentrations

taken from individual sumps tend to have an accumulative type error upon summation of calculated results. (c) Composite periodic type sampling results in an arithmetic average concentration instead of the actual prorated type based on the volume of individual concentrations.

In order to determine the origin of loss and initiate methods to effect reduction, tests were run on the following cascade waste streams:

(1) Cascade Seal Pots:

<u>Cascade No.</u>	<u>Alloy Kgs. Loss</u>
1 & 1A	0.004 kgs./ day
2	0.004 kgs./ day
3	0.006 kgs./ day
4	0.004 kgs./ day
5	0.006 kgs./ day
6	0.005 kgs./ day

These losses were determined by titrating a 50 ml sample of waste aqueous with 0.0793N H_2SO_4 . These waste streams maintain an approximate flow rate of 0.4 gpm each.

- (2) Vacuum System Entrainment Separators: This system indicated a loss of 9.3 kgs. per day during a test period in July, 1957. This loss is an average of spot checks taken at approximately 1030 each day for three days.

An effort was made to minimize the loss realized from this equipment by better operational procedures pertaining to spills, emptying equipment, and etc. Analyses of the waste streams from the vacuum equipment were again made the first of October and the loss figures had decreased to approximately 3.8 kgs. per day. The assay of this material checked to be an average of 16.0% with an average stability of 22.54. These results are an average of four sets of data taken at approximately 1030 each morning for four days.

At present, log sheets for logging the volume and concentration of the waste aqueous from each entrainment separator of the vacuum system has been incorporated in the routine operation of the plant. From this it can be determined whether or not a recovery system for this alloy loss will be feasible.

- (3) Alpha-5 Extract Area: The condensate from the evaporators in the extract area makes up almost entirely all of the waste effluent from this area. During the month of July this equipment operated approximately 18 days. A spot check was taken on this waste material and tested to be 0.006 moles/gallon. The flow rate of the condensate from this operation is approximately 12 gpm so a loss was found at this point of 12 kgs. of alloy for an 18 day period. This area now operates approximately four days per month. The remaining losses from this area are from spills and material poured in the lab sink, which can best be controlled by improved operational procedure.
- (4) Alpha-5 Feed Prep Area: This area operates only on emergency conditions and is down most of the time. The losses from this area are from spills and the decomposer aqueous overflow. This aqueous overflow should be a water solution of impurities primarily made up of potassium, sodium, and calcium. If there is any alloy of sizable amount found in this stream then it could be due to poor operations.
- (5) Solvent Wash System: There are three solvent wash systems each of which is composed of two solvent wash towers, one for an acid wash and the other for a water wash. The acid wash is operated only when there is a build up of impurities which is not being taken out with the water wash. When the acid wash is not being used the acid wash tower is still

operated as a water wash thus giving two water wash towers.

The losses due to the acid wash unit of this system are not presented here since operation as such was discontinued on June 26, 1957. A study has already been made of these losses and recommendations for a recovery system has been submitted by the Development Department.

The losses encountered from Solvent Wash System No. 3 serving Cascades 5 and 6 when both wash towers function as water wash towers are as follows:

E-413 Wash Water Flow Rate	10 GPM	5 GPM
Alloy Loss	0.102 kgs./ day or 3.06 kgs./ month	0.0612 kgs./ day or 1.84 kgs./ month
Solvent Loss	16.2 lbs./ day or 486 lbs. month	3.4 3.4 lbs./ day or 102 lbs./ month

The average losses encountered from Solvent Wash System No. 3 serving Cascades 5 and 6 when both towers function as water wash towers are as follows:

For 10 GPM wash water flow rate to E-413:

Sample No.	Location or Description	Solvent to Sewer (lbs./ day)	Alloy to Sewer (kgs./ day)	Waste Stream - Flow Rate GPM
1	F-403 overflow	8.29	0.032	5.20
3	E-413 overflow	7.64	0.034	9.80
5	F-433 overflow	0.12	0.022	0.20
7	F-423-1 overflow	0.16	0.007	0.57
8	F-433-1 overflow	0.01	0.007	0.36
Total		16.22 lbs./ day or 486 lbs./ month	0.102 kgs/ day or 3.06 kgs./ month	16.13 GPM

For 5 GPM wash water flow rate to E-413:

1	F-403 overflow	1.69	0.017	5.08
3	E-413 overflow	1.64	0.024	5.00
6	F-433 overflow	0.05	0.006	1.71
7	F-423-1 overflow	0.02	0.011	0.49
8	F-433-1 overflow	0.02	0.004	0.45
Total		3.42 lbs./ day or 103 lbs./ month	0.062 kgs./ day or 1.86 kgs./ month	12.73 GPM

A diagram of the sample points for Cascade 5 and 6 solvent wash system is presented in this report.

After the solvent losses were determined for the 10 gpm wash water flow rate to E-413 it was decided to lower E-413 wash water flow rate to 5 gpm on August 20, 1957, to determine if a solvent savings could be realized and also whether the overall alloy production would be affected. It is possible that in the channel of travel of the solvent wash system waste aqueous that the dissolved solvent has a tendency to precipitate out in the parts of the waste system that are more chemically basic. The above results were realized with no apparent change in the alloy production rate.

The results obtained for the 10 gpm water wash flow rate are an average of three sets of data for the alloy loss and the two sets for the solvent loss.

The results obtained for the wash water flow rate of 5 gpm are an average of four sets of data for the alloy loss and three sets for the solvent loss.

A spectrographic analysis of the solvent returning from Cascade 6 and the solvent returning to F-433 from the solvent wash system No. 3 was made from one set of spot type samples and the results reported in ppm on a solvent basis are as follows:

	Ag	Ca	Al	Cd	Na	V	Co	Cr	K	Ni	Zn	Ba
Solvent From Cascade	.3	< 1	10	< 3	12	< 3	< 3	< 1	15	< 1	< 30	< 1
Washed Solvent	1	< 1	15	< 3	30	< 3	< 3	< 1	20	< 1	< 30	< 1
	Li	Sn	Be	Cu	Mg	Pb	Sr	Fe	Mn			
Solvent from Cascade	< 1	< 3	< .3	< .3	< 1	< 1	< 3	< 30	< 1			
Washed Solvent	< 1	< 3	< .3	< .3	< 1	< 1	< 3	< 30	< 1			

MONTHLY TABULATIONS OF SUMF LOSSES

2-5 only

Y/HG-0347/Del Rev M-47

MONTH	GALLONS		KGS		ASSAY	# HG
	Total Indiv.	F-115C	Total of Ind.	F-115C	F-115C	F-115C
APRIL 1957		10,508,200	Sumptorles and waste torles	1,855.00		
MAY	10,765,236	0,274,140	3,023.62	2,526.81	7.72	
JUNE	9,427,210	7,012,880	3,471.61	2,280.64	8.10	516 1367.41?
JULY	11,819,168	9,707,800	2,357.82	1,508.25	0.39	367.41
AUGUST	9,618,160	6,534,510	2,050.31	1,471.39	8.14	✓ 973.56
SEPTEMBER	8,649,680	5,581,770	1,526.10	842.41	8.36	✓ 015.88
OCTOBER	7,343,290	5,503,538	081.86	863.03	0.57	507.51
NOVEMBER	5,417,500	3,686,340	1,133.69	811.47	11.46	636.38
DECEMBER	5,757,108	3,841,110	1,172.32	850.27	0.90	875.19
JAN 1958	5,551,416	3,928,520	1,360.38	1,472.38	8.89	1,807.59
FEBRUARY	6,431,086	5,007,360	1,018.07	1,031.71	10.72	1,421.86
MARCH	5,064,177	4,828,594	684.45	793.35	9.33	950.82
APRIL	3,823,064	3,694,380	354.13	414.90	13.54	1,744.90
MAY	4,772,714	3,951,610	331.48	341.81	8.10	1,259.22
JUNE	4,344,467	3,714,648	442.40	500.60	8.07	752.83
JULY	4,560,021	4,241,000	307.27	531.11	8.56	944.17
AUGUST	4,544,947	4,163,115	465.74	471.81	8.59	1,481.83
SEPTEMBER	4,328,044	4,406,350	432.34	622.23	6.91	905.70
OCTOBER	4,828,648	4,731,540	511.48	549.67	6.61	746.68
NOVEMBER	4,758,197	4,554,238	991.56	844.97	6.75	1,158.59
DECEMBER	4,771,436	5,443,080	850.65	1,411.95	11.08	549.08
JAN 1959	4,417,560	5,061,130	2,730.89	2,542.48	3.31	716.17
FEBRUARY	3,885,541	5,688,300	758.76	803.26	4.42	583.21
MARCH	1,163,825	3,788,850	112.00	997.99	27.26	388.33
APRIL						1688

January 1958, the average monthly losses from these sources has been 3122 Kgs.

of metal or 42,400 pounds of lithium hydroxide monohydrate. At \$0.70 per pound of lithium hydroxide monohydrate, this 42,400 pounds of losses of lithium hydroxide monohydrate is worth \$29,680 per month. The per cent loss of lithium is very small in comparison to the total volume of lithium which is handled daily in the buildings. In fact 42,400 pounds of lithium hydroxide monohydrate could be lost per month from a continuous leak of about [REDACTED]

ever, careful checks of the leakage from pumps indicate only trace amounts of lithium are being lost from these sources. It is assumed that the majority of

the known losses are from periodic small leaks which occur during normal operations of the plants. It is also assumed that the average assay of the losses from F-1150 at Alpha-4 and Alpha-5 will have an average assay of [REDACTED]. In the past the assay of the losses from F-1150 at Alpha-4 and Alpha-5 has fluctuated from [REDACTED]. The high assay loss is known to be mainly due to the losses which occur during full stream acid washing of the cascades mercury stream. High assays losses were about 6 Kgs of metal per day and are not to be considered in this letter. The loss of 42,400 pounds per month of lithium hydroxide monohydrate does not include the loss from the acid wash system.

At the present time all of the floor drains in the process areas and water from the mercury tanks in each building empty into a sump. The sumps (both called F-1150) are located behind the respective buildings adjacent to the railroad. The waste which enters the F-1150 sump at Alpha-4 is allowed to

18.42% Li
7810 lbs/mo

gravity flow to ^(EF)Poplar Creek. A continuous flow rate check is made of this stream and a composite of the stream is analyzed for lithium, sodium, potassium, calcium and mercury. The waste from F-1150 at Alpha-5 is pumped to ^(EF)Poplar Creek and daily flow rates and concentrations of the above mentioned elements are taken. Table 1 gives the monthly average loss from F-1150 of both Alpha-4 and Alpha-5 of lithium, sodium, calcium and potassium plus the daily average flow rates of both buildings.

TABLE 1

Average concentration of all metals	ug/ml
Average flow rate per day	gals/day
Average Kgs. daily loss (all metals)	231 Kgs/day (metal basis)
Average Kgs. daily loss (lithium)	101.6 Kgs/day (metal basis)
Average Loss of equivalent lithium hydroxide monohydrate per day	1352 lbs/day

Table 1 has been obtained from the records kept on Alpha-4 and Alpha-5 sump losses. This table is an average monthly loss based on the months of August 1957 through January 1958 but does not include the lithium lost from the acid wash system.

The F-1150 sumps at Alpha-4 and Alpha-5 were originally installed as a trap for mercury which could be lost from the buildings. The sumps were also designed so that neutralization of the waste stream could be done. However, the neutralization phase of operations has not been used. Periodically, these sumps are cleaned and the settled mercury and mercury compounds are removed. A six-month average loss indicates that the mercury leaving the sumps to Poplar Creek is a minimum of 1000 pounds per month. This loss does not include the mercury losses that occur when nitric acid washing of the mercury is required.

The wastes entering F-1150 sump can be isolated into three general categories:

1. Nitric acid wash system
2. Feed prep areas 20.4%
3. Cascade operations and auxiliary operations
other than feed prep areas.

The nitric acid solution comes from the acid wash system of the mercury in the cascades. During abnormal decomposition periods it is necessary to acid wash continuously at least one cascade in Alpha-4. In the past approximately 6 Kgs. of lithium per day was lost during full stream acid washing due to incomplete decomposition of the amalgam leaving the decomposers. This source of lithium loss decreased significantly as soon as all of the decomposers in

[] In any event the nitric acid waste stream cannot be processed in the proposed method of recovery due to the presence of the nitrate ions. The losses which may occur through this source will have to be salvaged by a different method.

The feed prep areas drain into fan rooms A and B at Alpha-4 and D and F at Alpha-5. These fan rooms are sampled daily for losses. Table 2 gives an average monthly measured loss from each fan room based on the months of September 1957 through January 1958 losses. These feed prep areas account for 275 pounds of lithium hydroxide monohydrate per day or 20.4 per cent of the total losses minus the nitric acid wash solutions. The waste from these sources contain 817 ppm of lithium in 7465 gallons of water per day. The wastes from this source may be reduced by better operations of the equipment. For this letter, however, these losses are included in the proposed method of recovery.

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Unclassified Title DRAFT "A PRELIMINARY STUDY OF THE RECOVERY OF LITHIUM AND MERCURY LOSSES" (M-815)

Author(s) Requestor: Steve Wiley *(adding pp. omitted from original request)*

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SECRET

Lithium

7

SUMMARY

On January 15, 1965 between 7:00 p.m. and 8:00 p.m., approximately 1,192 kilograms of 60 atom-percent lithium-6 was lost from a Building 9201-5 evaporator storage tank in the Y-12 Plant. The lost material, with a book value of about \$310,000, was an aqueous solution of lithium hydroxide. The solution was part of a larger volume being accumulated for subsequent concentration and crystallization to a solid for final storage. The loss occurred from Tank F-202 during an emergency transfer to alleviate a minor leak in Tank F-206. The cause of the loss was an error in identifying a pipeline strainer as a pipeline blank.

Salvage operations initiated after the spill recovered 52 kilograms of the lithium as retrieved solution. The irretrievable loss of lithium is, therefore, 1,140 kilograms with a book value of \$296,000.

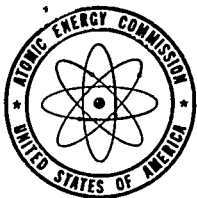
Union Carbide Corporation is the AEC cost-type management contractor for the management, operation and maintenance of the government-owned Y-12 Facility at Oak Ridge, Tennessee under Contract Number W-7405-eng-26.

SECRET

HISTORY OF MATERIAL

Sixty atom-percent assay lithium-6 deuteride material from returned weapons was being processed in Building 9204-2 to recover the deuterium for reuse. This is accomplished by reacting the lithium-6 deuteride with water. The deuterium is liberated as a gas, and the lithium is converted to the hydroxide form in solution. The residual deuterium concentration in the solution is about 0.00005 grams per gram of solution or 0.005 weight-percent and is not economically practical to recover. The lithium concentration in the solution is approximately 12 gram-moles (77 grams) per gallon. Since there is no immediate requirement for 60 atom-percent enriched lithium-6, the batches of hydroxide solution from the deuterium recovery operation were being accumulated for storage processing. This consists of concentrating the solution to an aqueous slurry of lithium-6 hydroxide monohydrate ($\text{LiOH} \cdot \text{H}_2\text{O}$) crystals and subsequent separation of the crystals from the liquor. The crystalline salt is stored in drums. The concentration and crystal salt recovery operation was intended to be accomplished in a crystallizing evaporator system located in Building 9201-5. This system was formerly used to crystallize lithium hydroxide tails from the lithium isotopes separation plant.

In order to utilize the crystallizing evaporator system effectively and economically, a continuous feed from a substantial supply has to be provided. It was intended to accumulate about 150,000 to 200,000 gallons of the enriched lithium hydroxide solution to provide an adequate feed



IN REPLY REFER TO:

OPA:WBK

UNITED STATES
ATOMIC ENERGY COMMISSION

✓ cys 5 and 6 to R. F. Hibbs
cy 7 to R. G. Jordan
cy 8 to R. A. Winkel
cy 9 to Plant Records

CEC 3/2/65

Oak Ridge, Tennessee 37831

February 26, 1965

Code: Q16
HIBBS' FILE CENTER

Union Carbide Corporation
Nuclear Division
Post Office Box P
Oak Ridge, Tennessee 37831

Attention: Dr. C. E. Larson, President

Subject: REPORT OF INVESTIGATING COMMITTEE - "LOSS OF
SPECIAL NUCLEAR MATERIAL AT THE Y-12 PLANT"

Gentlemen:

Transmitted herewith are Parts 1, classified Secret R/D,
and 2, unclassified, of the subject report. Immediate
steps should be taken to implement the recommendations
of the Committee.

Periodic reports should be submitted giving progress on
implementation of the recommendations until all required
actions are completed.

Please convey to Messrs. J. J. Kurtz, F. V. Tilson, H. T.
Kite, and H. N. Benninghoff of the Y-12 Plant, my appreciation
for their participation on the Committee.

Very truly yours,

S. R. Sapirie
S. R. Sapirie
Manager
Oak Ridge Operations

Enclosures:

1. Part 1 (6) - ORO-125208
2. Part 2 (6)

CC: Mr. R. C. Armstrong
w/o Encls.

SECRET

THIS DOCUMENT

OF 52 PAGES

NO. 5

25

DOCUMENT NUMBER

ORO 125208 PT1 5 25A

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INVENTORIED JUL 9 1975

U. S. ATOMIC ENERGY COMMISSION

REPORT OF INVESTIGATING COMMITTEE

LOSS OF SPECIAL NUCLEAR MATERIAL AT Y-12 PLANT

ON JANUARY 15, 1965 (U)

Prepared by

Union Carbide Corporation

Nuclear Division

Y-12 Plant

U. S. ATOMIC ENERGY COMMISSION

OAK RIDGE OPERATIONS OFFICE

OAK RIDGE, TENNESSEE

7/15/68 VY
11-15-69 KOS
1-11-71 KOS
12-20-71 One
1-15-73 Sju
1-16-74 Sju
12-10-74 Sju

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m478

from Y/H6-0203

5

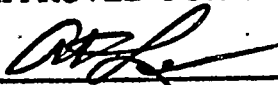
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PART 2

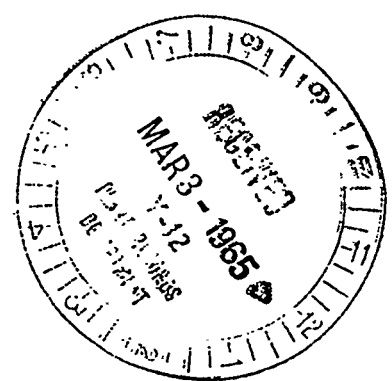
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U.S. ATOMIC ENERGY COMMISSION
REPORT OF INVESTIGATING COMMITTEE
LOSS OF SPECIAL NUCLEAR MATERIAL AT Y-12 PLANT
ON JANUARY 15, 1965

APPROVED FOR PUBLIC RELEASE

Technical Information Office Date 8/25/74

Prepared By
UNION CARBIDE CORPORATION
NUCLEAR DIVISION
Y-12 PLANT

U.S. ATOMIC ENERGY COMMISSION
OAK RIDGE OPERATIONS OFFICE
OAK RIDGE, TENNESSEE



INVESTIGATING COMMITTEES CONCLUSIONS AND RECOMMENDATIONS
LOSS OF SPECIAL NUCLEAR MATERIAL AT Y-12 PLANT
JANUARY 15, 1965

Part 1 of the Investigating Committee report, ORO-125208, described the incident and presented certain findings of fact. This report is to present the conclusions and recommendations of the Committee.

Table 4.7. Summary of accidental losses to the ground

Location	Date	Estimated quantity spilled (lb)	Estimated losses (lb)
#1 9201-2	1951-1955 (3 spills)	100,000-120,000	#1 ~95,000 US: 108,000 (Stoner 1983) Visible mercury shoveled. Dirt sent to Building 81-10. Unable to recover much mercury in ground at spill
#1 9202	1953-55		#2 ~70,000 #1b 50,000 (Stoner 1983) Visible mercury recovered, some lost to ground through floor inventory shortage - not a spill (see p. 139)
#2 9201-5	01/01/56	113,000-170,000	# ~40,000 Visible mercury shoveled; dirt sent to Building 81-10, unable to recover much mercury in ground at spill
#3 Ramp area north of 9201-5	07/17/56	22,500-90,000	# Visible mercury shoveled; dirt sent to Building 81-10, unable to recover much mercury in ground at spill
#4 Between 9204-4 and 9201-5	mid-1956	22,500-90,000	# Visible mercury shoveled; dirt sent to Building 81-10, unable to recover much mercury in ground at spill
#5 9201-5	11/15/56	22,500-45,000	# ~85,000 Visible mercury recovered, some lost to ground through floor
#5 1-15 1965	Light only		# ~85,000 #5b Y/HG-0203 and ORD-125208
#6 9201-5	03/28/66	✓ 105,000	#6 49,853-lb measured loss to ground; dirt sent to Building 81-10, unable to recover much mercury in ground at spill
TOTAL		380,500-515,000	~424,853

*Dirt from spills not segregated from other materials processed through Building 81-10; therefore, no data on amount recovered are available.

Estimates are based on mercury losses through seams in floors, cracks in floors, and unrecoverable mercury in the ground. Mercury would continue to go deeper into the ground during recovery operations with backhoes and shovels.

424853
- 49853
375,000

**UNION
CARBIDE**

INTERNAL CORRESPONDENCE

NUCLEAR DIVISION

POST OFFICE BOX Y, OAK RIDGE, TENNESSEE 37831

To (Name) J. J. Kurtz
Company
Location

Date January 29, 1965
Originating Dept Radiation Safety

Answering letter date

Copy to J. D. McLendon *J.D.*

Subject Poplar Creek pH Experience

The charts recording the pH continuously on the upstream and downstream side of New Hope Lake are collected weekly by the Health Physics Department. These charts are checked for longterm pH deviation between 6.3 and 8.6 on the discharge side of the pond. Significant deviations are investigated with operations in order to ascertain the possible causes and sources of contaminate. The attachment gives a summary of typical pH experience for fourteen weeks prior to large caustic release of January 15, 1965.

M. Sanders
M. Sanders
Health Physics Department

MS:ep

NEW HOPE POND pH DISCHARGE

<u>Week Ending</u> <u>Date</u>	<u>pH Range</u> <u>High</u> <u>Low</u>		<u>Hours below 6.3</u> <u>Hours above 8.5</u>
10-02-64	7.6	6.8	0
10-09-64	8.2	6.9	0
10-19-64	9.3	7	12
10-23-64	9.8	7.4	51(1)
11-02-64	9.2	7.2	52(1)
11-06-64	8.4	7.6	0
11-13-64	8.8	7.6	14
11-20-64	9.2	7.4	8
11-27-64	9	6.2	3
12-04-64	8.6	6.6	2
12-11-64	8.8	3.4	0
12-23-64	8.6	7.2	0
12-31-64	9	7.4	2
1-11-65	10.7	7	108(2)

Comments -

- (1) Per Neal Dow - Discharging some per chlorates to drain since tank truck not available from ORGDP.
- (2) Notified PSS 1-13-65 (R. W. Brothers) that the discharge side of pond was above 8.6 for a total of 108 hours for week ending 1-11-65. Mr. Brothers was asked to note this condition in log book at PSS. Mr. Brothers stated that utilities had dumped some 150 gallons of H_2SO_4 during the period in question with no other unusual condition recorded by his office, however, D. W. Smith during this period was in process of bagging and cleaning up salt. Notified Haywood Taylor, 1-13-65, of Beta 2, of condition. Mr. Taylor stated that there was no unusual condition in his area which could contribute to situation.

Notified D. W. Smith, 1-13-65, about unusual condition and discussed possibility of his salt clean-up contributing to high caustic values in stream, however, it was generally agreed that this operation would not likely be the source. Mr. Smith stated he did have a considerable amount of caustic solution stored in various tanks and would check these for leaks, etc.

Notified Patterson, 1-13-65, of Plating Shop of unusual condition. Mr. Patterson stated that no material or solution was discharged from his operation for the report period.

Lithium Air Losses

BLDG 9204-2	Air Conc (ug/m3)	Avg by area		Avg no outliers	AVG all areas		BLDG 9201-4	Stack Conc (g/min)	Avg
Evaporator Area	11.5	212.4		11.5	23.5	154.1	Salt Drumming	156.3	33.3
Mar-55	1.4			1.4			Operation	18.4	
	2101.6						Aug-55	17	
	120.6			120.6				12.4	
	35.7			35.7				8.7	
	14.2			14.2				11	
	36.9			36.9				0.46	
	2.1			2.1				13.8	
	5.4			5.4				11	
	5.3			5.3				8.3	
	2.0			2.0				17.5	
Furnace Area	52.9	26.2						101.2	
Mar-55	21.2							36.8	
	25.1							27.6	
	17.5							50.6	
	39.7							76.4	
	23.3							96.6	
	3.4							119.6	
Reduction Area	3.9	11.2						5.98	
Mar-55	8.7							4.14	
	21.4							3.22	
	12.3							1.84	
	21.4							0.23	
	4.9							0.78	
	11.0								
	5.6								
Bird Bath Area	42.9	703.9		42.9	115.5				
Mar-55	6000.0								
	12.5			12.5					
	2.6			2.6					
	266.7			266.7					
	4.4			4.4					
	5.3			5.3					
	2.5			2.5					
	700.0			700.0					
	2.5			2.5					
Storage Tank Area	2.2	3.3							
Mar-55	2.6								
	5.0								
Reactor Loading	17.2	59.8							
Platform	2.5								
Mar-55	16.0								
	2.5								
	2.5								
	420.0								
	110.0								
	8.9								
	8.3								
	10.0								
Filter Press Area	2.5	9.2							
Mar-55	4.1								
	20.0								
	10.0								
Guard Portal	2.5	11.9							
Mar-55	2.5								
	5.8								
	3.4								

Lithium Air Losses

BLDG 9204-2	Air Conc (ug/m3)	Avg by area		Avg no outliers	AVG all areas		BLDG 9201-4	Stack Conc (g/min)	Avg
	37.0								
	20.0								
Fabrication Area	32.0	65.7							
Mar-55	42.0								
Apr-55	192.0								
	116.0								
	15.0								
	19.8								
	45.5								
	86.0								
	22.0								
	50.0								
	32.0								
	13.2								
	18.4								
	55.0								
	30.0								
	40.0								
	14.2								
	28.0								
	5.8								
	137.5								
	22.0								
	52.0								
	500.0								
	142.0								
	3.5								
	20.0								
	40.0								
Knock Out Area	24.0	107.6	24.0	36.7					
Mar-55	47.0		47.0						
Apr-55	27.5		27.5						
	27.5		27.5						
	37.5		37.5						
	28.5		28.5						
	1100.0								
	136.0		136.0						
	11.2		11.2						
	14.0		14.0						
	21.0		21.0						
	90.0		90.0						
	16.0		16.0						
	9.7		9.7						
	24.0		24.0						
Dust Fusion Room	11.5	11.0							
Mar-55	10.0								
Apr-55	11.6								
Mold Loading Room	5244.0	549.1		27.5					
Apr-55	12.8		12.8						
	27.2		27.2						
	80.0		80.0						
	19.4		19.4						
	21.0		21.0						
	50.0		50.0						
	9.8		9.8						
	15.0		15.0						
	12.0		12.0						

Lithium Air Losses

BLDG 9204-2	Air Conc	Avg		Avg	AVG		BLDG 9201-4	Stack Conc	Avg
	(ug/m3)	by area		no outliers	all areas			(g/min)	
Salvage Area	30.0	81.5							
Mar-55	420.0								
Apr-55	93.0								
	18.8								
	2.4								
	3.3								
	3.0								
Machining Area	8.0	139.9							
Apr-55	21.0								
May-55	15.6								
	10.6								
	30.5								
	182.0								
	5.3								
	4.0								
	2.5								
	10.7								
	6.9								
	9.2								
	2.5								
	150.0								
	2.5								
	2.5								
	2.5								
	2.5								
	2.5								
	1360.0								
	140.0								
	20.0								
	435.0								
	2.5								
	2.5								
	2.5								
	337.0								
	500.0								
	470.0								
	110.0								
	16.2								
	600.0								
	150.0								
Blending & Molding	6.7								
Jan-56	6.7								
	41.7								
	33.3								
	8.0								
	95.2								

Unit Emissions

Model Output
Unit Concentrations

Model Output														
Unit Concentrations														
		Concentration Based on Unit Emissions												
Sources		S92014	S92015	S92041	S92042	S92043	S92011	S92012	S92013	S9202	S9212-1	S9212-2	S9212-3	S9212-4
receptor 1		UTM-X	UTM-Y											
1109	746000	3986000	0.1060	0.1050	0.1953	0.1829	0.1581	0.3070	0.3156	0.3562	0.5879	1.1722	1.2303	1.0133
1305	754000	3990000	0.0476	0.0459	0.0535	0.0531	0.0519	0.0565	0.0605	0.0603	0.0632	0.0709	0.0654	0.0956
1352	754000	3991000	0.0376	0.0364	0.0396	0.0409	0.0388	0.0410	0.0421	0.0429	0.0505	0.0552	0.0505	0.0510
1353	755000	3991000	0.0374	0.0362	0.0408	0.0408	0.0398	0.0426	0.0439	0.0451	0.0452	0.0548	0.0507	0.0608

Scarboro receptor

1109 = Scarboro receptor

1305 = Downvalley Receptor

1352 = Downvalley Receptor

1353 = 1353 → are also 1305.

1352 + 1353 → are from JKL

flow rate building = 27.7

flow rate building = 27.7 m³/secconc
μg/m³ × flow rate
$$\frac{1.4 \text{ m}}{18 \text{ m/s}} \times \frac{9}{100} \times \frac{1}{100} \times \text{VER's}$$

flow rate 1 Ton

receptor incomplete

not a Ton
are done conc of
over 100 ft.Li ≠ U
Li ≈ Hg

Unit Emissions

S9212.5	S9206	SX10	SK25		
1.1897	0.1827	0.0087	0.0323		
0.0845	0.0562	0.0075	0.0151		
0.0498	0.0427	0.0069	0.0147		
0.0500	0.0430	0.0069	0.0139		

Iso: avg. 3-8 bldg. in 2-4 stack
 154.0 $\mu\text{g}/\text{m}^3$ (Sampling times)
 33.3 $\text{g}/\text{min} \rightarrow 0.56 \text{ g}/\text{sec}$

INTER-COMPANY CORRESPONDENCE

(INSERT NAME) COMPANY CARBIDE AND CARBON CHEMICALS COMPANY LOCATION Post Office Box Y OAK RIDGE, TENN.

TO
LOCATION **W. K. Whitson, Jr.
Bldg. 9201-4**

DATE **June 27, 1955**

ATTENTION
COPY TO

**R. D. Williams
H. G. Taylor
J. L. Williams
L. C. Emerson
File ✓**

ANSWERING LETTER DATE

SUBJECT **Alloy Air Concentrations
in Bldg. 9204-2**

The following tables show air concentrations of Alloy in micrograms per cubic meter in various areas of Bldg. 9204-2.

A tentative level of 35 micrograms per cubic meter has been established from a comfort stand point rather than a toxic one. Recent animal experimentation has shown that toxic levels are those in the 5 milligrams and above range. Nasal septum perforation was also noted in these higher concentrations.

Evaporator Area

<u>Date</u>	<u>Remarks</u>	<u>Time Minutes</u>	<u>Concentration Alloy ug/M³</u>
3-16-55	GA Normal Area, no dust visible No open pots	22	11.5
"	GA - ditto	23	1.4
"	B2 unloading evaporator, dusty operation	10	2,101.6
"	B2 - dusty operation, very little dust visible	10	120.6
3-17-55	GA at column J-39	30	35.7
"	Ditto	83	14.2
"	Ditto - except J-32	29	36.9
3-21-55	Ditto - except enhanced area	42	2.1
"	Ditto	33	5.4
"	Ditto - J-27 in Salvage area 1 at Bird Bath #3	100	5.3
"	Sample taken while loading Bird Bath with Chloride	90	2.0

(Continued on Page 2)

Furnace Area

<u>Date</u>		<u>Time Minutes</u>	<u>ug/M³</u>
3-16-55	Breathing Zone: loading alloy in- to furnace, removing metal	6	52.9
"	Ditto	12	21.2
3-17-55	General Air at Column D-35	35	25.1
"	Ditto	80	17.5
"	Ditto - except C-33	30	39.7
3-21-55	Ditto - except D-33	43	23.3
"	Ditto	29	3.4

Reduction Area

3-16-55	General Air between furnace #17 & 18	65	3.9
"	Ditto	22	8.7
3-17-55	General Air behind furnace #16	36	21.4
"	Ditto - except #15	80	12.3
"	Ditto - at Column M-16	41	21.4
3-21-55	Ditto - M-19, Hot part setting in open	41	4.9
"	Ditto - except L-16	36	11.0
"	Ditto L-16	92	5.6

Bird Bath Area

3-22-55	B2 unloading Bird Bath #05-C-103-2, Dusty operation	21	42.9
"	B2 - ditto - #05-C-203-4	8	6000.0
"	GA sample at column J-37	20	12.5
3-23-55	GA - ditto - J-43	39	2.6
"	B2 unloading Bird Bath #05-C-103-3	6	266.7
"	GA at Bath #05-C-303-4, 40% material	45	4.4
"	GA at Bath #05-C-303-3, ditto	19	5.3
"	GA at Bath #05-C-1004-3 (Salvage Area) after unloading	15	<2.5
3-24-55	B2 unloading Bath #05-203-4, Dusty operation	10	700
"	GA loading Bath #05-C-203-4 with alloy Chloride	24	<2.5

Storage Tank Area

3-22-55	GA at Column L-32	46	2.2
"	Ditto L-39	38	2.6
"	Ditto L-32	20	5.0
3-25-55	GA at tank #05-F-503-C	29	17.2

(Continued on Page 3)

Reactor Loading Platform

<u>Date</u>		<u>Time Minutes</u>	<u>ug/m³</u>
3-23-55	GA at reactor platform (2 cans dust near by)	45	<2.5
"	Ditto	34	16.0
"	Ditto	26	<2.5
"	Ditto	15	<2.5
3-24-55	B2 drilling metal in reactor, dusty operation	5	420.0
"	B2 ditto	10	110.0
"	B2 after unloading reactor	28	8.9
"	GA - ditto	24	8.3
"	Ditto	30	10.0

Filter Press Area

3-23-55	Gen. air in area	42	<2.5
"	Ditto	37	4.1
3-25-55	GA at press #05-C-1007-1	30	20.0
"	Ditto	20	10.0

Guard Portal

3-24-55	Gen. Air at post	22	<2.5
"	Ditto	30	<2.5
"	Ditto	28	5.8
"	Ditto	29	3.4
3-25-55	Ditto	27	37.0
"	Ditto	15	20.0

Fabrication Area

3-30-55	GA in A-line Crusher Area 1st floor	25	32.0
"	Ditto	19	42.0
"	B2 in A-line Crusher area at blending operation	38	192
"	Ditto - Shaker - ditto	9	116
3-31-55	GA in A-line Crusher area at 2nd floor	40	15
"	Ditto	24	19.8
4-5-55	B2 in A-line - ditto - over Salvage Screen	38	25.5
4-6-55	GA - ditto - top floor (Crusher operating)	39	86
3-31-55	GA in B line Crusher area 2nd floor	27	22
4-4-55	GA ditto - top floor	8	50
"	B2 ditto - loading metal in crusher	15	32
"	GA ditto - after loading metal in crusher	24	13.2
"	B2 ditto - loading metal in crusher	13	18.4

(Continued on Page 4)

Fabrication Area
(Continuation)

<u>Date</u>		<u>Time</u> <u>Minutes</u>	<u>ug/H³</u>
4-5-55	GA in B line Crusher area 1st floor	33	55
"	Ditto - 2nd floor	32	30
"	B2 at B line crusher area at blending operation	10	40
"	GA ditto - 2nd floor	28	14.2
"	Ditto - 1st floor	29	28
"	B2 - ditto - top floor (loading platform)	40	5.8
"	Ditto - 1st floor blending operation	8	137.5
4-6-55	Ditto - loading crusher	4	22
"	Ditto - crusher in operation	10	52
"	Ditto - loading crusher	2	500
"	GA - ditto - crusher in operation	10	142
"	Ditto - top floor	115	3.5
4-7-55	B2 at C line crusher 2nd floor	24	20
"	Ditto	20	40

Knock out Area

3-30-55	B2 by desk	27	24
"	Ditto	30	47
"	GA in knock out area	27	27.5
3-31-55	Ditto - at Column K-12	29	27.5
"	Ditto	26	37.5
4-4-55	Ditto - near knock out box	40	28.5
"	Ditto - at mold loading machine, dusty	40	1100
4-5-55	Ditto - near knock out box	31	136
"	Ditto	40	11.2
"	Ditto - near knock out hood	32	14
"	Ditto	51	21
4-6-55	GA between knockout hood & molding loading machine	40	90
"	GA in knockout room	110	16
"	Ditto - near hood	48	9.7
3-31-55	GA in room 208	35	24

Dust Fusion Room

3-31-55	GA in Room 227 at Column K-7	39	11.5
4-1-55	Ditto	64	10
"	Ditto	55	11.6

(Continued on Page 5)

Hold Loading Room

<u>Date</u>		<u>Time Minutes</u>	<u>ug/m³</u>
4-1-55	GA in M&I loading room #229	70	12.8
"	Ditto - near large M&I	51	5244.0
4-4-55	Ditto	33	27.2
"	Ditto	45	80.0
4-6-55	Ditto	36	19.4
"	Ditto - loading room #229	108	21
"	Ditto - near large M&I	49	50
4-7-55	Ditto - loading room #229	31	9.8
"	Ditto - near large M&I	27	15
"	Ditto - loading room #229	60	12

Salvage Area

3-31-55	GA in room 231 - no operations	30	30
"	GA in room 231 - removing metal from hood	29	420
4-1-55	GA in room 231	69	93
"	Ditto	53	18.8
4-7-55	Ditto	37	2.4
"	Ditto	27	3.3
"	Ditto	60	3.0

Leo J. LaFrance
Leo J. LaFrance
Industrial Hygienist
Medical Department

LJL/dal

INTER-COMPANY CORRESPONDENCE

(INSERT NAME) COMPANY CARBIDE AND CARBON CHEMICALS COMPANY LOCATION Post Office Box Y
OAK RIDGE, TENN.

TO
LOCATION

ATTENTION
COPY TO

J. M. Case
Bldg. 9218

C. A. Rinderer
L. G. Lankford
L. C. Emerson
File ✓

DATE

June 27, 1955

ANSWERING LETTER DATE

SUBJECT

Alloy Concentrations
in Air in Machine Shop
at Bldg. 9204-2

The following samples were taken in the Machine Shop areas of 9204-2 to determine the air concentrations of Alloy dust.

A tentative level of 35 micrograms per cubic meter has been established from a comfort stand point rather than a toxic one. Recent animal experimentation has shown that levels in excess of 5 milligrams per cubic meter may be toxic. Nasal septum perforation was also noted at these elevated levels.

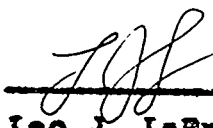
Machining Area

<u>Date</u>		<u>Time Minutes</u>	<u>ug/m³</u>
4-18-55	West Shop Gen. Air at Column K-16	25	8
"	Ditto - K-14	23	21
"	West Shop B2 at drill press #1	23	15.6
"	West Shop Gen. Air at Column K-16	19	10.6
"	Ditto - K-14	21	30.5
"	West Shop B2 at drill press #1	21	182
4-25-55	East Shop Gen. Air at Column L-32	34	5.3
"	East Shop Gen. Air in storage area south of Insp.	38	4.0
"	East Shop Gen. Air at Col. L-30	32	2.8
"	East Shop Gen. Air at Machine #281	25	10.7
"	East Shop Gen. Air at Col. M-32, Removing part from machine #34	23	6.9
5-6-55	East Shop Gen. Air at Storage Area south of Insp.	22	9.2
"	Gen. Air between machine #26 & 27 both in oper.	30	<2.5
"	Gen. Air Hood opened about 5 min.	50	150
"	B2 opening door and removing parts from mach. #21	2	<2.5
"	B2 dusting parts with rag under exhaust duct	2	<2.5
"	B2 opening door and removing part from mach. #15	2	<2.5

(Continued on Page 2)

Machining Area
(Continuation)

<u>Date</u>		<u>Time Minutes</u>	<u>ug/M³</u>
5-9-55	GA at Col. M-9 West Shop	45	<2.5
"	Opening door and removing part from mach. #21	4	<2.5
"	B2 opening door and changing tool at mach. #13	7	1360
"	B2 opening & closing door mach. #13, part vacuumed & checked	8	140
5-10-55	GA Col. #7 near loading dry box	50	20
"	B2 opening door, removing part, replacement part Mach. #19	3	435
"	B2 opening door, removing part, bushing dust from log mach. #9	5	<2.5
"	GA between machine #548	45	<2.5
5-12-55	GA at Col. L-32 near blending dry box	60	<2.5
"	B2 opening door, hammering & removing part mach. #2	8	337
"	B2 brushing dust from part at exhaust duct Col. M-9	2	500
"	B2 opening door Removing part Mach. #19	3	470
"	B2 vacuum out mach. #17. Door open	10	110
"	GA Col. M45 East Shop	55	16.2
"	B2 opening door & resetting part mach. #28	2	600
"	B2 opening door, hammering & removing part mach. #25	12	150



Leo J. LaFrance
Industrial Hygienist
Medical Department

LJL:dai

INTER-COMPANY CORRESPONDENCE

(INSERT NAME) COMPANY CARBIDE AND CARBON CHEMICALS COMPANY LOCATION Post Office Box Y
OAK RIDGE, TENN.

TO J. L. Williams
LOCATION 9204-2

DATE February 9, 1956

ANSWERING LETTER DATE

ATTENTION
COPY TO H. D. Whitehead
L. C. Emerson
File (Y-12 RC)✓

SUBJECT Air Analysis

Air samples were taken on January 30, 1956, to determine the levels of Alloy during blending and molding operations in the Aspen Chemical Area in Building 9204-2.

<u>Date</u>	<u>Location</u>	<u>ug Ay/m³</u>	<u>Remarks</u>
1-30-56	BZ unloading blender through dry box L-925-13 into mold can.	6.7	Small dust leak at mold can boat.
"	BZ removing mold can from bottom of dry box L-925-13	6.7	Small amount of dust at this time.
"	BZ unloading blender through dry box L-925-7 into mold can.	41.7	Dust leak at mold can boat.
"	BZ removing mold can from bottom of dry box L-925-7	33.3	Small amount of dust at this time.
"	BZ unloading blender through dry box L-925-14 into mold can.	8.0	
"	BZ removing mold can from bottom of dry box L-925-14 and capping off.	95.2	Considerable amount of dust during this operation.

General Comments concerning all of above samples:

1. Vibrator in operation.
2. "B" line operation.

Newell E. Bolton
Newell E. Bolton
Assist. Industrial Hygienist
Medical Department

NEB:dip

INTER-COMPANY CORRESPONDENCE

(INSERT NAME) COMPANY CARBIDE AND CARBON CHEMICALS COMPANY LOCATION Post Office Box Y OAK RIDGE, TENN.

UNCLASSIFIED

TO
LOCATION

**D. A. Jennings
Bldg. 9201-4**

DATE

August 19, 1955

ATTENTION
COPY TO

**W. K. Whitson
H. C. McBirney
L. C. Emerson
File ←**

ANSWERING LETTER DATE

SUBJECT

Stack Samples at 9201-4.

RESTRICTED

This document contains restricted data as defined in the Atomic Energy Act of 1946. Its transmittal or the disclosure of its contents in any manner to an unauthorized person is prohibited.

The following samples were taken 8/17/55 at the Exhaust Stack for the Salt Drumming operation in 9201-4. The results are on a grams per minute basis during the sampling period. Stack and sampling rates were 4600 and 1 CFM respectively.

<u>Date</u>	<u>Time</u>	<u>Concentration of Salt in grams/minute</u>
8-17-55	10:03-10:21	18 min 156.3
"	10:24-10:54	30 18.4
"	12:04-12:34	30 17.0
"	12:36-13:06	30 12.4
"	13:07-13:39	32 8.7
"	13:38-14:08	30 11.0

The loss in pounds for the total time sampled was 10.6.

It is indicated from this and previous samples already reported that if the stack velocity is increased to move more air from around the drumming operation the losses would warrant a scrubber in the exhaust system. This would reclaim salt and prevent excessive amounts of salt getting into the general plant atmosphere.

[Signature]

**Leo J. LaFrance
Industrial Hygienist
Medical Department**

FEB 5 1990

LJL:dai

UNCLASSIFIED

Derivative Classifier R. M. Gill Cons.
(Name and title)

UNCLASSIFIED

INTER-COMPANY CORRESPONDENCE

(INSERT
NAME)

COMPANY CARBIDE AND CARBON CHEMICALS COMPANY LOCATION Post Office Box Y
OAK RIDGE, TENN.

TO
LOCATION

D. A. Jennings
Bldg. 9201-4

ATTENTION
COPY TO

W. K. Whitson
H. C. McBirney
L. C. Emerson
File ✓

DATE

August 18, 1955

ANSWERING LETTER DATE

SUBJECT

Stack Samples at 9201-4.

CONFIDENTIAL

RESTRICTED DATA

This document contains restricted data as defined
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or the use of its contents in any manner to
an unauthorized person is prohibited.

The following samples were taken in the Exhaust Stack for the Salt Drumming Operation in 9201-4 to determine the amounts being vented. The Stack Exhaust Rate is 4600 CFM. The results below are on a grams per minute basis during the sampling period. The sampling rate was 1 CFM for 30 minutes.

<u>Date</u>	<u>Time</u>	<u>Concentration of Salt in grams/minute</u>
8/3/55	12:04-12:34	0.46
"	12:36-13:06	13.8
8/4/55	08:35-09:05	11.0
"	09:07-09:37	8.3
"	09:39-10:09	17.5
"	10:10-10:40	101.2
"	12:02-12:32	36.8
"	12:33-13:03	27.6
"	13:27-13:57	50.6
"	13:58-14:28	76.4
"	14:31-15:01	96.6
"	15:02-15:32	119.6
8/11/55	10:20-10:50	5.98
"	11:57-12:27	4.14
"	12:29-12:59	3.22
"	13:00-13:30	1.84
"	13:31-14:01	0.23
"	14:02-14:32	0.78

The loss in pounds for the period sampled on 8/4/55 was 36. A possible explanation for the low losses on 8/11/55 is that the extract system had been down for the previous 36 hours.

(continued on page 2)

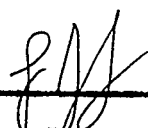
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Page 2
August 18, 1955

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Further samples are being taken at this location to better evaluate the possible losses if ventilation rates are increased on this stack to aid in the comfort of the work area around the drum loading chutes.



Leo J. LaFrance
Industrial Hygienist
Medical Department

LJL:dai

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INTER-COMPANY CORRESPONDENCE
UNION CARBIDE NUCLEAR COMPANY
A Division of Union Carbide and Carbon Corporation

To:

Plant:

L. G. Lankford
Bldg. 9204-2

Date: June 12, 1956

Copies To:

Subject:

C. A. Rinderer
L. G. Emerson
File Y-12 RC ✓

Dust Samples in
Appen Area

The following are the results of dust loadings in micrograms per cubic meter while various filter combinations were being tested on machine dry box #23, 5-29-56.

With Dry Box Exhaust Duct Disconnected.

1 inch above filter while purging.	Regular filter	0.5 ug/m ³
	New Test filter	208 ug/m ³
1 inch above filter while machining.	Regular filter	2.7 ug/m ³
	New Test filter	4.3 ug/m ³

With Dry Box Exhaust Duct Connected *
* Exhaust turned off except for purging.

1 inch above filter while purging.	Regular filter	1.6 ug/m ³
	New Test filter	830 ug/m ³
	New Test filter	
	Plus add. filter	39 ug/m ³
1 inch above filter while machining.	Regular filter	3.9 ug/m ³
	New Test filter	1.7 ug/m ³
	New Test filter	
	Plus add. filter	11 ug/m ³

From the above data it is apparent that the new test filter is not as effective as that currently in use, especially under purging conditions.

Leo J. LaFrance
Industrial Hygienist
Medical Department

LJL:ema

INTER-COMPANY CORRESPONDENCE
UNION CARBIDE NUCLEAR COMPANY
A Division of Union Carbide and Carbon Corporation

To:

Plant:

L. G. Lankford
Bldg. 9204-2

Date: October 9, 1956

Copies To:

Subject:

C. A. Rinderer
J. D. Molendon
File (Y-12RC) ✓

Filter Test Samples
in Aspen Area

The following tables present three series of tests on different filter media used to trap effluent material from dry boxes in the Aspen Area. Samples were taken under both varying purging and machining conditions. All results are in micrograms per cubic meter.

1st. Series taken from 6/18 - 6/21/56

Type of Filter - BM2133 Confo dust filter

	<u>Machining</u>	<u>Purging</u>
Single Filter	52	862
" "	36	172
" "	76	43
" "	101	201
" "	30	113
" "	17	167
Double Filter	115	230
" "	36	230
" "	28	86
" "	33	71
Triple Filter	50	316
" "	72	862
" "	-	86
" "	14	476

Type of Filter - Soft Pink

Single Filter	65	431
" "	108	190
Double Filter	48	476
" "	14	190
Triple Filter	50	476
" "	23	190

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2nd. Series taken from 7/17 - 20/56.

Type of Filter - CWS - 6

	<u>Machining</u>	<u>Purging</u>
CWS-6	0.63	1.15
CWS-6	0.49	0.73

Type of Filter - Felt

Single Filter	7	146
" "	4	234
Double Filter	3	92
" "	2	73
Triple Filter	3	70
" "	24	439

Type of Filter - EM2133 Confo Dust Filter

Single Filter	3	35
" "	3	42
Double Filter	2	88
" "	2	146
Triple Filter	29	58
" "	7	-

Type of Filter - National 808-M

Single Filter	2	110
" "	3	1095

3rd. Series taken from 9/17 - 19/56.

Type of Filter - Felt

Double Filter	6	29
" "	9	19
" "	18	0.9
" "	5	11
" "	7	8
" "	7	7
" "	6	1
" "	12	8
" "	9	2
" "	4	19
" "	3	2
" "	5	15

Due to changes in the manner in which the filters were mounted the 3rd. series gave the most consistent set of data. In both machining and purging the effluent concentrations is less than one microgram per cubic foot.

L. J. LaFrance

Leo J. LaFrance
Industrial Hygienist
Medical Department

LJL:emm

OAK RIDGE Y-12 PLANT INFORMATION CONTROL FORM

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Author's / Requestor's Name S. W. Wiley Telephone No., Pager No. and Plant Address 6-0263, 417-5417, 9106, MS-8023 Account Number 2366-0002

INTENDED AUDIENCE: ☐ Public ☐ Environmental Regulators ☐ NWC ☐ DOE Contractors ☒ Other ChemRisk

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DOCUMENT: Level UNIC Category NA

S. W. Wiley
Print Name Signature Date 2/25/97

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S. W. Wiley TOA/HS Coordinator

Please Print Name and Title

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Signature Date

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18-4-10

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Classifier R. M. Gill Cons.
(Name and title)

FEB 5 1990

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THE DETECTION OF A LITHIUM ISOTOPE SEPARATION PLANT

A Completion Report

by

Raymond L. Walker
Ernest F. Blase

June 1960

Analytical Chemistry Division
Oak Ridge National Laboratory

Operated for the

U. S. Atomic Energy Commission

by

Union Carbide Nuclear Company

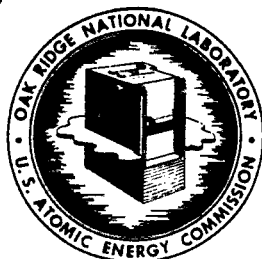
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OAK RIDGE NATIONAL LABORATORY

Operated by
UNION CARBIDE NUCLEAR COMPANY
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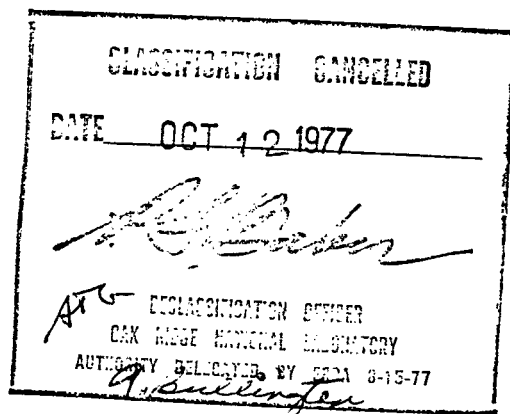
DATE: June 1960
SUBJECT: A Completion Report
TO: J. A. Swartout
FROM: A. E. Cameron

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D. R. Harris 11/27/95
Technical Information Officer Date
ORNL Site



THE DETECTION OF A LITHIUM ISOTOPE SEPARATION PLANT

A Completion Report

by

Raymond L. Walker
Ernest F. Blase

June 1960

Analytical Chemistry Division
Oak Ridge National Laboratory

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S. R. Sapirie, ORO

CONCLUSIONS

This laboratory was assigned the problem of detecting a lithium isotope separation plant by isotopic analysis of the air-borne and water-borne effluent.

It was demonstrated that the maximum distance a lithium isotope separation plant could be detected by analysis of the air-borne effluent is 25 miles. To achieve even a reasonable degree of confidence at distances greater than five miles from the plant, techniques which differentiate between air-borne effluent and the natural background must be employed.

The water-borne effluent from a lithium isotope separation plant is detectable at least 200 miles away by the increased concentration of lithium in the rivers, and at least 300 miles away by the change in the isotopic composition from natural lithium.

PART A - Air-borne Effluent

Introduction

The detection of a lithium isotope separation plant by change in the isotopic ratio of lithium in nearby vegetation has been investigated. This study was centered around the isotope separation plant at Oak Ridge.

Associated studies have been made on the variation of isotopic ratio of the lithium in vegetation near a lithium processing plant where no isotope separation is accomplished. Studies of the lithium in rain water near an isotope separation plant and a brief investigation of the change in lithium-rubidium ratio in soil near a lithium plant due to excessive lithium losses were also made.

In this report, analytical results are reported in smidgens (1 sm = 1 ^{micro}gram). not grams
93/70 = 13.3

Summary

Previous studies have established that natural lithium minerals can vary in isotopic ratio (7/6) between 12.44 and 12.93.¹ Investigation of background lithium around the Foote Mineral Company's plant near Sunbright, Virginia, show variations of greater than 1% (12.39 to 12.55) are possible in a relatively small (80 square mile) area.

For the detection of a lithium isotope separation plant by isotopic analysis of the lithium in evergreen needles, one is limited to a radius of less than 25 miles for a large industrial facility comparable to Oak Ridge. To achieve even a reasonable degree of confidence at 5 miles, it is necessary to differentiate between the natural background and air-borne effluent. This can be done in several ways:

1. By washing the needles and comparing the isotopic ratio of the lithium in the wash solution with the isotopic ratio of the lithium in the washed needles, bark, or soil from that area. Washing the needles to remove lithium works equally well on fresh or air-dried needles.
2. Or, assuming some integration of isotopically altered lithium by the needles during the growing season, a comparison of the needles with either the bark or soil can be made. This technique is much less sensitive.

due to detection limits
The collection of air-borne lithium in rain water was limited to a distance of 8 miles from the Y-12 plant. Oak leaves and pine needles were sampled at each water collection site. A large and inconsistent variation in isotopic ratio was found in the rain water. Except for one sample at 1.9 miles, the pine needles were in the range of normal lithium and viewed independently would not be indicative of a lithium isotope separation plant in the area.

1. Cameron, A. E., JACS, 77, 2731 (1955).

The oak leaf samples collected at the area showed a wide variation in isotopic ratio of lithium. There was no evidence of integration of the air-borne lithium in the leaf, but rather the leaf seems merely to collect some of the current losses.

A preliminary investigation of the lithium-rubidium ratio in soil was performed. Russian results² indicate a narrow range of lithium concentration in various types of soils and plants. The concentration of rubidium in soils also lies within narrow limits but there is an enrichment of rubidium in plants. The change in concentration of lithium in soils around Oak Ridge due to air-borne effluent does not alter the lithium-rubidium ratios significantly.

Experimental Techniques and Results

A conventional 60°, six-inch radius, first order focusing mass spectrometer was modified to collect the two lithium isotopes simultaneously. A ratio recording system was employed so a direct 6/7 ratio was observed. One hundred sm. samples were mounted on 2-56 stainless steel washers as lithium fluoride and a single rhenium filament was used both to evaporate the neutral molecules and to serve as a hot surface to form ions. All the samples were submitted to the operator as unknowns. Frequent checks on the accuracy were made by running laboratory standards as unknowns. It was shown experimentally that the equipment would reproduce to within 0.25% of the ratio. This precision was only required on samples that were in the range of natural lithium and was not necessary for many of the samples where an error of 1% in the ratio would not be significant.

A series of pine needle and bark samples were collected May 26, 1959, at distances of 1, 2, 5, and 10 miles radially northeast of the lithium plant in Oak Ridge. Table I is a summary of the lithium isotopic ratios found in this investigation. No washing of the samples to differentiate between background lithium and Oak Ridge effluent was attempted.

It is obvious that little, if any, air-borne lithium is associated with the bark of a tree. The lack of retention of lithium by bark has been demonstrated in the laboratory in an attempt to use bark as an ion exchange medium. Any anomalous isotope ratios in bark samples are probably due to particulate matter that has not been washed off by rain.

An isotopic analysis of the total needle sample shows a detectable variation from the normal isotopic ratio up to five miles from the plant. At 10 miles, no variation over background was found even though the total lithium content was about twice the expected amount.

2. Ivanov, D. N., Soil Science, 2, 32-45 (1954).

A second set of samples was collected on December 12, 1959. This group, collected at 1, 5, 10, 15, and 25 miles radially northeast of the lithium separation plant consisted of needles, bark, and soil. Half of each sample of needles was allowed to air dry for a few months in the laboratory. In order to differentiate between air-borne effluent and the natural background, the needles were washed in water with an ultrasonic generator. The wash solution was then filtered and an isotopic analysis was performed on the washed needles, the wash solution, and the filtered solids. The results are tabulated in Table II and compared with the soil and bark from the same site. It is interesting to note that the wash solution was enriched in the mass 6 isotope and the washed needles were enriched in the mass 7 isotope. This indicates some occlusion or absorption of air-borne lithium by the plant during the growing season. The washing technique, whether on fresh or air-dried samples, extends detection capability to 25 miles.

A further analysis of the data in Table II shows a close agreement between the lithium leached from the soil and the bark at 5, 10, 15, and 25 miles. At 1 mile, the isotopic ratio of the lithium in the uppermost layer of the soil may be altered due to the plant effluent. The isotopic ratio of the solids from the wash solution and the dissolved soil samples were included in the study but no interpretation is pertinent. 12.21
164

Table III is a summary of the leaf, bark, and needle samples collected in October 1958, near the Foote Mineral Company's plant at Sunbright, Virginia. The variation in isotopic ratio of the lithium found at this location, where no isotope separation is accomplished, illustrates the necessity of differentiating between air-borne plant effluent and natural background before an interpretation can be made of a routine analysis.

In May 1958, rain water collectors were placed around Oak Ridge at ten different locations. Three series of samples were collected during the four month period. At each location, one pine needle and one oak leaf sample were taken when the rain water collectors were first placed. Samples of oak leaves were also taken at the end of each rain water collection period.

Table IV lists the data for the rain water samples. It is apparent that lithium of altered isotopic ratio can be detected in rain water up to at least 8 miles. There is no agreement between the isotopic ratio of the lithium in the rain water at different locations, which is additional evidence of the inconsistent nature of the air-borne losses from the Oak Ridge plant. The collection of larger rain water samples may be coupled with ion exchange techniques to concentrate the lithium to extend the distance so that it could be a useful clandestine method for detection of a lithium separation plant but it is doubtful if the range would ever be as much as 25 miles. or weather winds

Table V lists the data for the oak leaf and pine needle samples collected at the same location as the rain water samples. The samples were not washed and accordingly represent the natural background plus accumulated air-borne

material. The majority of these samples were within the range of natural lithium but were not representative of the known isotopic ratios of lithium in soil around Oak Ridge.

12.21

The ratio of total lithium to total rubidium in soils, reported by the Russians to lie within very narrow limits, was investigated to determine if the effluent from the Oak Ridge plant was enough to change the ratio significantly. Table VI lists the results of this study. No significance can be attached to this ratio for the purpose of detection of a lithium plant.

Conclusions

It has been experimentally demonstrated that the inherent difficulties in detecting a lithium isotope separation plant by isotopic analysis of lithium in vegetation, i.e., the variation of the lithium 7/6 ratio in nature, the abundance of lithium in soils and vegetation, the solubility of lithium effluent and negligible occlusion or absorption in foliage indicate the small probability of detecting a lithium isotope separation facility by analyzing foreign vegetation samples without other reasons for suspecting the area.

which isotope released in effluent?
any environmental transformation ${}^6\text{Li} \rightleftharpoons {}^7\text{Li}$? (like Cr)

TABLE I

Analytical Results from the May 26, 1959

Bark and Vegetation Samples Near Oak Ridge

① --- NE ↗

<u>Distance From Plant (Miles)</u>	<u>Type</u>	<u>Conc. sm/gm</u>	<u>Lithium 7/6</u>
1	Needles	564	13.23
1	Bark	334	12.46
2	Needles	558	13.74
2	Bark	524	12.48
5	Needles	649	12.76
5	Bark	1,585	(12.52)* 12.53
10	Needles	309	(12.51)* 12.48
10	Bark	1,467	12.49

*Duplicate runs.

more 'li

Analytical Results from the December 12, 1959 Bark, Vegetation, and Soil Samples Near Oak Ridge

TABLE II

Distance From Plant (Miles)	Washed Needles more 'li		Wash	Solids	Leached Soil more 'li	Bark		Wash From Dried Needles more 'li	Dissolved Solids Lithium 7/6 Ratio
	Lithium Conc. sm/gm.	Lithium 7/6 Ratio				Lithium Conc. sm/gm.	Lithium 7/6 Ratio		
1	406	12.82	9.17	12.15	12.21	1,010	12.45	12.41*	-
5	129	12.54	12.12	12.27	12.47	455	12.42	12.19	-
10	155	12.58	12.47	12.45	12.47	516	12.45	12.32	12.48
15	159	12.49	12.21	12.44	12.45	819	12.46	11.70	12.53
25	89	12.56	12.36	12.44	12.53	314	12.51	12.36	12.47

*This sample was not part of original - collected next day at same location. Also, this sample had partly decayed when washed.

Miscellaneous

W. Ridge	(3.5 miles)	- Needles	12.35
		- Wash	11.07
Fort Loudon	(12 miles)	- Needles	12.45
		- Wash	12.15

605 6001

TABLE III

Analytical Results from October 1958

Bark and Vegetation Samples Near Sunbright, Virginia

<u>Sample Number</u>	<u>Type</u>	<u>Location</u> <u>(Miles from Plant)</u>	<u>Lithium</u> <u>Conc. sm/gm.</u>	<u>Lithium</u> <u>Ratio 7/6</u>
312	Bark	5 S	401	12.50
313	Needles	"	102	12.45
314	Leaves	"	252	12.42
315	Bark	5 E	649	12.44
316	Needles	"	219	12.50
317	Leaves	"	490	12.41
318	Cedar	"	488	12.55
319*	Moss	"	9,607	12.50
320	Bark	2 E	1,228	12.41
321	Cedar	"	846	12.43
322	Leaves	"	822	12.48
323	Bark	2 S	1,126	12.41
324	Needles	"	2,407	12.42
325	Leaves	"	1,060	12.43
326	Bark	2 W	1,636	12.39
327	Needles	"	8,715	12.39
328	Leaves	"	5,830	12.52
329	Bark	5 W	586	12.53
330	Needles	"	5,564	12.43
331	Leaves	"	3,170	12.50
332	Bark	5 N	224	12.49
333	Needles	"	289	12.41
334	Leaves	"	342	12.46

*Moss sample included some soil from ground.

-5

-2

N
7 7

X 1
4 B

TABLE IV

Analytical Results from Rain Collecting Experiment Near Oak Ridge

<u>Sample Number</u>	<u>Type Sample</u>	<u>Distance and Direction From Y-12 Plant</u>	<u>Sampling Period</u>	<u>Total Li, Sm</u>	<u>Lithium Ratio 7/6</u>
200 A	Water	1.7-SSE	5-8-58 - 6-10-58	480	13.79 ↑7
B	"		6-10-58 - 8-5-58	530	14.16
C	"		8-5-58 - 9-10-58	470	10.02 ↑6
203 A	"	3.1-WSW	5-8-58 - 6-10-58	1,013	12.90
B	"		6-10-58 - 8-10-58	508	12.95
C	"		8-5-58 - 9-10-58	473	11.85 ✓
206 A	"	1.9-NE	5-8-58 - 6-10-58	1,425	12.36
B	"		6-10-58 - 8-5-58	1,908	15.34
C	"		8-5-58 - 9-10-58	1,201	15.67
209 A	"	8-SW	5-8-58 - 6-10-58	438	12.38
B	"		6-10-58 - 8-5-58	510	12.71
C	"		8-5-58 - 9-10-58	375	12.30
212 A	"	7.2-WSW	5-8-58 - 6-10-58	656	11.68 ✓
B	"		6-10-58 - 8-5-58	1,917	12.69
C	"		8-5-58 - 9-10-58	435	12.93
215 A	"	3.5-WNW	5-8-58 - 6-10-58	475	12.50
B	"		6-10-58 - 8-5-58	698	12.58
C	"		8-5-58 - 9-10-58	484	14.12
218 A	"	4.9-NE	5-8-58 - 6-10-58	1,425	12.56
B	"		6-10-58 - 8-5-58	3,208	13.51
C	"		8-5-58 - 9-10-58	650	14.08
221 A	"	5.4-NNE	5-8-58 - 6-10-58	925	12.27
B	"		6-10-58 - 8-5-58	2,050	13.48
C	"		8-5-58 - 9-10-58	600	13.18
224 A	"	6.8-W	5-8-58 - 6-10-58	525	12.24
B	"		6-10-58 - 8-5-58	675	12.41
C	"		8-5-58 - 9-10-58	300	12.85
*227 A	"	2-NNE	5-8-58 - 6-10-58	1,531	12.12
B	"		6-10-58 - 8-5-58	2,531	13.19

*Sampler located on housetop in Woodland section of Oak Ridge.

12.44-12.97

TABLE V

Analytical Results from Vegetation Samples Near Oak Ridge

<u>Sample Number</u>	<u>Type Sample</u>	<u>Distance and Direction From Y-12 Plant</u>	<u>Sampling Date</u>	<u>Li Conc. sm/gm</u>	<u>Li Ratio 7/6</u>
201	Pine Needles	1.7-SSE	5-8-58	136	12.38
202 A	Oak Leaves	"	5-8-58	42	12.39
B	"	"	6-10-58	44	12.53
C	"	"	8-5-58	115	12.23
D	"	"	9-10-58	76	12.61
204	Pine Needles	3.1-WSW	5-8-58	122	12.45
205 A	Oak Leaves	"	5-8-58	86	12.59
B	"	"	6-10-58	239	12.50
C	"	"	8-5-58	94	12.30
D	"	"	9-10-58	224	12.58
207	Pine Needles	1.9-NE	5-8-58	371 (N)	11.70 - 6.1
208 A	Oak Leaves	"	5-8-58	187	11.95 -
B	"	"	6-10-58	196	12.11
C	"	"	8-5-58	300 (D)	12.48
D	"	"	9-10-58	424 (D)	12.23
210	Pine Needles	8-SW	5-8-58	150	12.41
211 A	Oak Leaves	"	5-8-58	22	12.39
B	"	"	6-10-58	96	12.51
C	"	"	8-5-58	117	12.33
D	"	"	9-10-58	240	12.33
213	Pine Needles	7.2-WSW	5-8-58	515 (N)	12.45
214 A	Oak Leaves	"	5-8-58	53	12.44
B	"	"	6-10-58	125	12.24
C	"	"	8-5-58	143	12.27
D	"	"	9-10-58	137	12.48
216	Pine Needles	3.5-WNW	5-8-58	375 (N)	12.64
217 A	Oak Leaves	"	5-8-58	111	12.63
B	"	"	6-10-58	229	12.45
C	"	"	8-5-58	219	12.39
D	"	"	9-10-58	356 (D)	12.32
219	Pine Needles	4.9-NE	5-8-58	278 (N)	12.39

TABLE V (Continued)

Analytical Results from Vegetation Samples Near Oak Ridge

<u>Sample Number</u>	<u>Type Sample</u>	<u>Distance and Direction From Y-12 Plant</u>	<u>Sampling Date</u>	<u>Li Conc. sm/gm</u>	<u>Li Ratio 7/6</u>
220 A	Oak Leaves	4.9-NE	5-8-58	81	12.63
B	"	"	6-10-58	167	12.54
C	"	"	8-5-58	359 (L)	12.50
D	"	"	9-10-58	446 (L)	12.62
222	Pine Needles	5.4-NNE	5-8-58	287 (P)	12.41
223 A	Oak Leaves	"	5-8-58	40	12.54
B	"	"	6-10-58	236	12.48
C	"	"	8-5-58	246	12.69
D	"	"	9-10-58	394 (L)	12.54
225	Pine Needles	6.8-W	5-8-58	416 (N)	12.56
226 A	Oak Leaves	"	5-8-58	167	12.52
B	"	"	6-10-58	198	12.44
C	"	"	8-5-58	227	12.47
D	"	"	9-10-58	482 (L)	12.20

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TABLE VI

Rubidium-Lithium Ratio in Soils Near Oak Ridge

<u>Laboratory Sample No.</u>	<u>Distance And Direction From Y-12 Plant</u>	$\times 10^2$ <u>Rb/Li.</u>
701	1-NE	1.84
704	5-NE	1.30
707	10-NE	4.80
710	15-NE	2.81
713	25-NE	3.20

17-337

PART B - Water-borne Effluent

Introduction

In November 1958, the water of a portion of the Tennessee Valley Authority drainage area was sampled in order to determine the concentration and isotopic composition of the lithium. There were two reasons for doing this: (1) to observe the contribution of a commercial lithium plant, where no isotope separation is performed, to the total lithium concentration; and (2) to observe the contribution to total lithium concentration and change in isotopic composition due to the Oak Ridge separations plant.

In March 1959, the study was repeated to confirm the November 1958 results. Because foreign water samples are easily compromised and difficult to obtain, consideration has been given to taking advantage of natural integrators which are associated with rivers.

Summary

It has been established that lithium from a processing plant such as the Foote Mineral Company's plant at Sunbright, Virginia, can be traced several hundred miles in river water merely by a knowledge of the lithium concentration and flow rates of the water system. Typical background concentrations of lithium in river water (0.3 sm/ml - 2.0 sm/ml) were increased to as much as 90 sm/ml near the plant and were still greater than the normal background concentration 200 miles away.

It has further been demonstrated that the effluent from a lithium isotope separation plant alters the isotopic composition of the lithium in the river water farther than 300 miles away. It is entirely possible to locate a lithium isotope separations plant from a series of water samples and do this successfully in the presence of excessive amounts of normal lithium in the water.

A four week survey of the concentration and isotopic ratio of the lithium in Poplar Creek illustrated the wide variation in effluent from the Oak Ridge separations plant.

An investigation of fish and driftwood, as well as vegetation in which the root system obviously was near water that contained isotopically altered lithium, indicated these techniques are much less sensitive than an analysis of the raw water.

Experimental Techniques and Results

The isotopic analyses of the lithium samples were made on a 60° six-inch radius mass spectrometer. A single collector was used and a magnetic scanning technique was used to alternately detect the ion beams of interest. The amplified signal was "bucked down" with precision put and take decade

resistors. The 50 sm. samples of lithium iodide were mounted on a triple filament source similar to that described by Inghram³, or a double filament source developed by A. E. Cameron, in which the ionizing surface was a coil of tungsten wire. A few of the samples were run on the ratio recording spectrometer previously described.

The area that was sampled and each sampling site are shown on the map in Appendix I. The lithium concentration and the lithium 7/6 ratio are given at those sampling sites that are included on the map.

Table I is a compilation of the data on all the samples taken in November 1958. Some of the samples listed in Table I do not appear on the map because these are not pertinent to the experiment except to show the normal concentration and isotopic composition where no separations plant is involved.

In March 1959, the sampling was repeated. Table II is a compilation of the data from the samples taken in March 1959. It is notable that the same trend was found but different concentrations and isotopic ratios were found. This is to be expected since the effluent from the plant showed a wide variation.

From Tables I and II, it is obvious that the Oak Ridge lithium isotope separations plant can be accurately located from a series of water samples. It is possible to calculate the contribution to the lithium concentration in the rivers by the Oak Ridge facility if the flow rates and, therefore, the dilution is known. Accordingly, it is then possible to calculate the concentration of lithium at any point downstream knowing the flow rates. The close agreement between the theoretical and experimental values for the dilution, as shown in Table III, supports the original calculation for estimating the water-borne effluent losses from Oak Ridge. Figure I is a plot of the data presented in Table III and illustrates the addition of a considerable quantity of lithium between Norris and Watts Bar. Although the concentration below Norris is low, there is a big difference in quantity because of the large increase in volume and flow after the Clinch River spills into the Tennessee River. The calculated amount that Oak Ridge must contribute, based on the preceding arguments, is 15 pounds of lithium per hour.

The most important aspect of the survey is the greatly altered isotopic composition of the lithium in the river after the Oak Ridge contribution. Figure II is a plot of the data of Table I and illustrates the distances which the abnormal isotopic ratio persist, at least 300 miles downstream.

3. Inghram, M. G., and Chupka, W. A., Rev. Sci. Inst. 24, No. 7, (518-520) 1957.

The wide variation in quantity and isotopic ratio of the Oak Ridge water-borne effluent are shown in Table IV. For this four week survey, it appears losses are a mixture of Li^7 tails, Li^6 product, and normal feed material. It is notable though, and logically so, that there is less care in handling of the tail-end material.

Table V lists the data obtained on driftwood, leaves, and fish, which could act as natural integrators of the isotopically altered lithium. Indications of a lithium isotope separation plant may be obtained from such samples but the results are inconclusive.

Conclusion

It is apparent that the most effective way to detect a lithium isotope separations plant is by the water-borne effluent. In doing so, it is possible to take advantage of the physical and chemical properties of lithium that limit the usefulness of analyzing vegetation samples.

TABLE I

Analytical Results from the November 1958 Water Samples

<u>Sample Number</u>	<u>Date</u>	<u>Sampling Site</u>	<u>Li Conc. sm/ml</u>	<u>Li 7/6 Ratio</u>
310	10-19-58	Clinch River above Stock Creek spillage near Clinchport, Virginia	2.0	12.70
311	10-19-58	Clinch River below Stock Creek spillage near Clinchport, Virginia	90	12.43
346	11-18-58	Clinch River 10 miles east of Tazewell, Tennessee	73	12.34
347	11-18-58	Powell River 4 miles east of Harrogate, Tennessee	2.1	12.58
345	11-18-58	Below Norris Dam	11	12.58
348	11-20-58	Below Fort Loudon Dam	0.5	13.11
349	11-20-58	Below Watts Bar Dam	6.1	17.90 ^{Li}
350	11-20-58	Hiwassee River 16 miles preceding spillage into Tennessee River	0.3	12.85
351	11-20-58	Below Chickamauga Dam	4.5	15.63 ^{Li}
352	11-20-58	Below Hales Bar Dam	3.7	15.25
245	7-17-58	Kentucky Lake near Paris, Tennessee	0.6	13.58

TABLE II

Analytical Results from the March 19, 1959 Water Samples

<u>Sample Number</u>	<u>Sampling Site</u>	<u>Li Conc. sm/ml</u>	<u>Li 7/6 Ratio</u>
518	Clinch River 10 miles east of Tazewell, Tennessee	33	12.47
515	Powell River 4 miles east of Harrogate, Tennessee	2.1	12.58
524	Below Norris Dam	9.9	12.44
535	Below Fort Loudon Dam	0.4	12.81
531	Below Watts Bar Dam	3.38	15.93 [^] 761
529	Hiwassee River 16 miles preceding spillage into Tennessee River	0.3	12.81
527	Below Chickamauga Dam	2.45	15.43

TABLE III

Experimental and Theoretical Results Using TVA Flow Data to Calculate
Theoretical Lithium Concentration from Dilution

November 1958 Flow Data

<u>Flow-Rate</u> <u>Checking Site</u>	<u>Flow l/sec.</u>	<u>Experimental</u> <u>Li Conc. sm/ml.</u>	<u>Theoretical</u> <u>Li Conc. sm/ml.</u>
Near Clinchport	6,230	90	-
Tazewell	7,930	73	71
Norris	137,330	11	6.1
Watts Bar	617,300	6.1	2.7
Chickamauga	900,450	4.5	1.82
Hales Bar	827,000	3.7	1.96

TABLE IV

The Determination of Lithium in the East Fork of Poplar Creek

A Four Week Survey

<u>Sample Code</u>	<u>Date Sampled</u>	<u>Li Conc. sm/ml.</u>	<u>Li 7/6 Ratio</u>
24	10-21-57	1,550	-
26	10-22-57	1,850	-
27	10-23-57	1,060	14.30 7
28	10-24-57	1,550 ✓	11.89 6
29	10-25-57	1,000	12.67
30	10-26-57	4,000	17.21 7
31	10-27-57	970	-
32	10-28-57	1,300	-
33	10-29-57	1,050 ✓	10.81 6
34	10-30-57	2,200	-
35	10-31-57	2,170	12.95 6/7
36	11-1-57	910	-
37	11-2-57	1,060	16.21
38	11-3-57	1,810	-
39	11-4-57	2,620	14.33
40	11-5-57	1,870	-
41	11-6-57	1,310 ✓	11.45 6
50	11-7-57	1,730	-
51	11-8-57	1,050	-
52	11-9-57	910	-
53	11-10-57	1,300	-
54	11-11-57	900	-
55	11-12-57	12,500	20.95 7
56	11-13-57	1,430	-
57	11-14-57	650	-
58	11-15-57	380	-
62	11-16-57	70 (heavy rain)	11.82
63	11-17-57	240	-

TABLE V

Some Analytical Results of Natural Integrators

Sample A - Driftwood, Poplar Creek, about 10 miles from plant perimeter.
Sample buried in creek bed with only a small piece projecting into water.

Sample B - Driftwood, Watts Bar Lake, about 30 miles from plant perimeter.

Sample C - Leaves from weeds. Same location as Sample B.

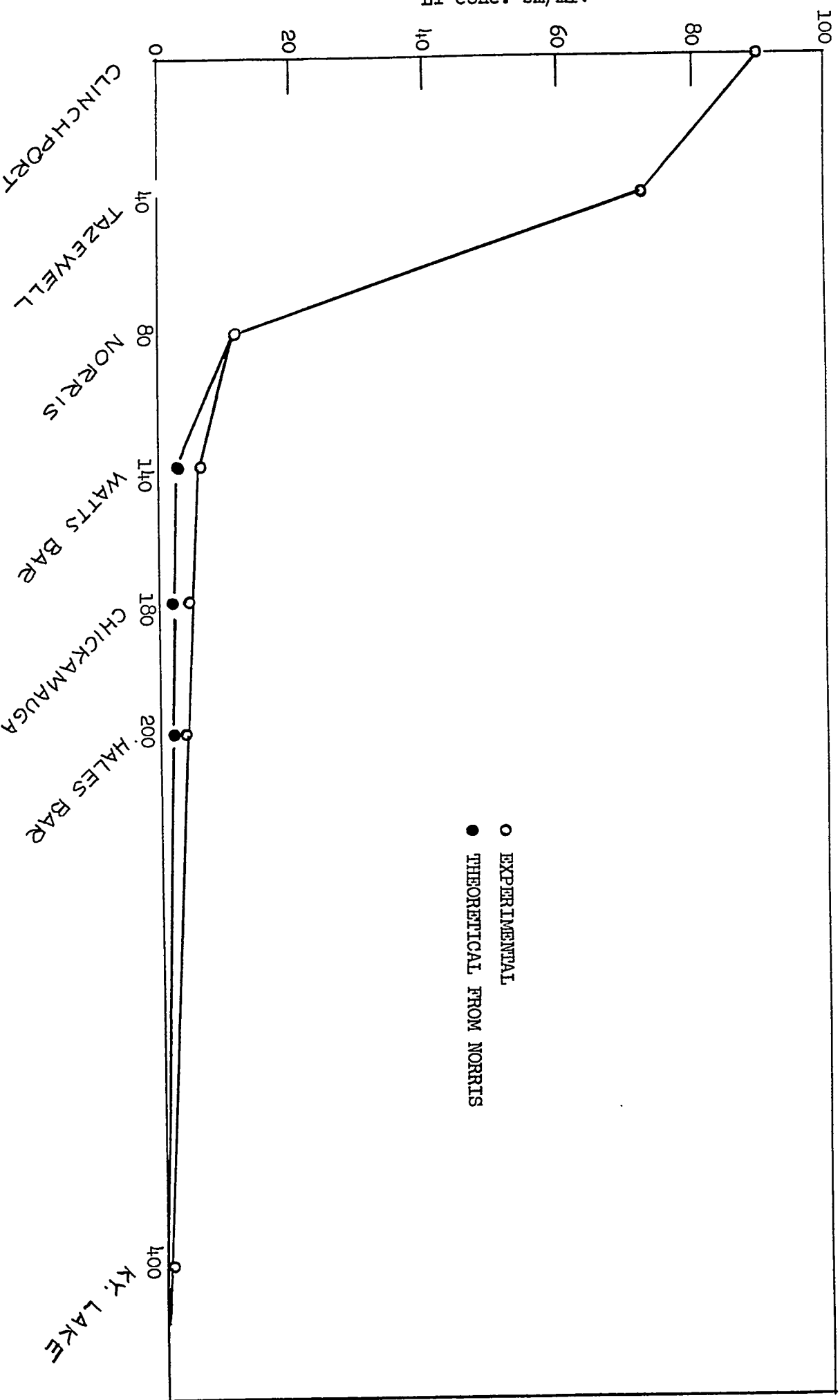
Sample D - Leaves from willow. Same location as Sample B.

<u>Sample</u>	<u>Li Conc. sm/gm.</u>	<u>7/6 Ratio</u>
A	4,980	12.85
B	1,006	12.93
C	194	12.55
D	51	12.58

Fish from Watts Bar and Norris Lake - Lithium 7/6 Ratio

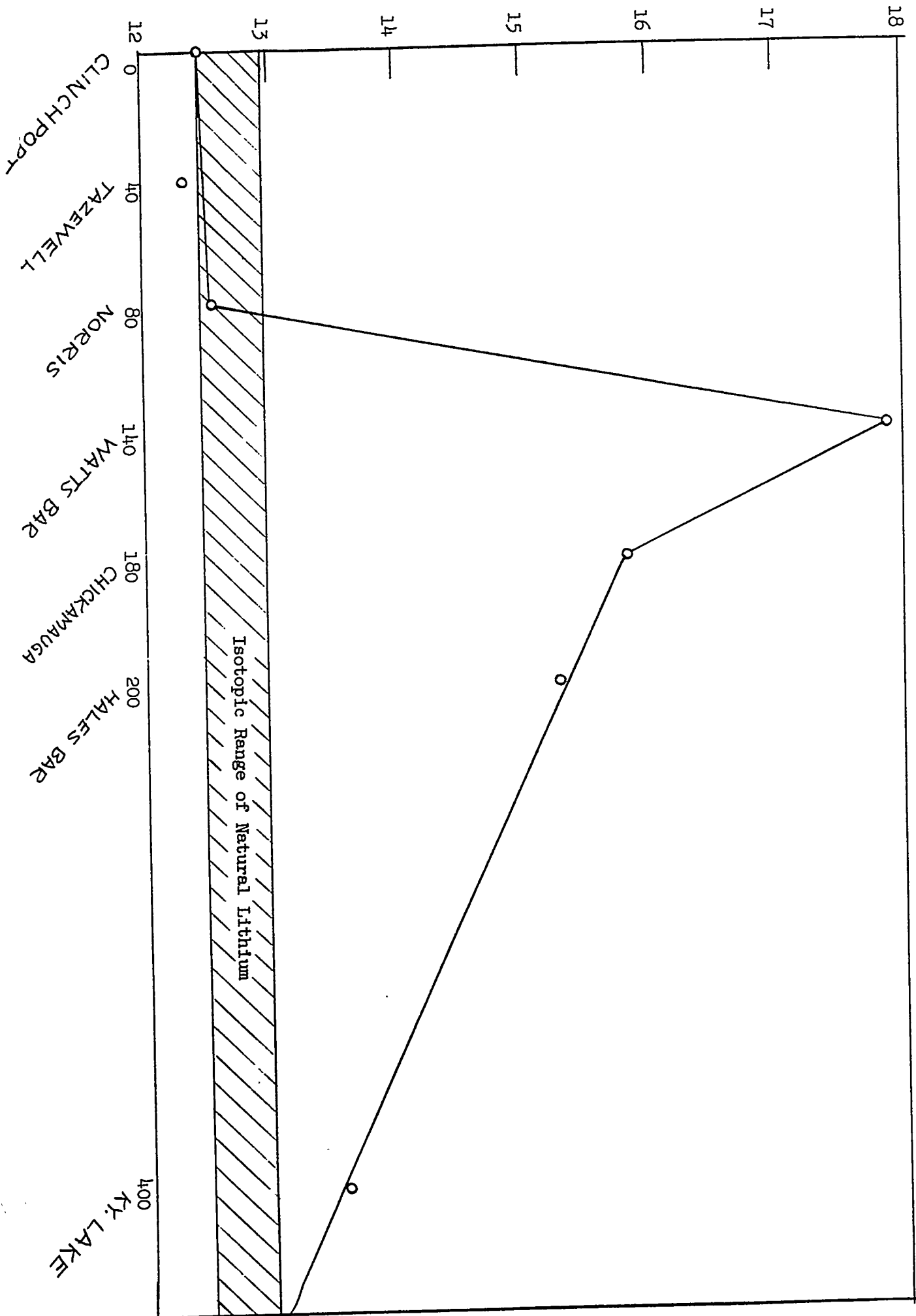
	<u>Head and Scales</u>	<u>Fillet</u>	<u>Entrails</u>
Watts Bar	13.06	12.65	12.82
Norris	-	12.46	12.42

FIGURE I. The Effect of the Y-12 Plant Effluent on the Downstream Dilution of Lithium



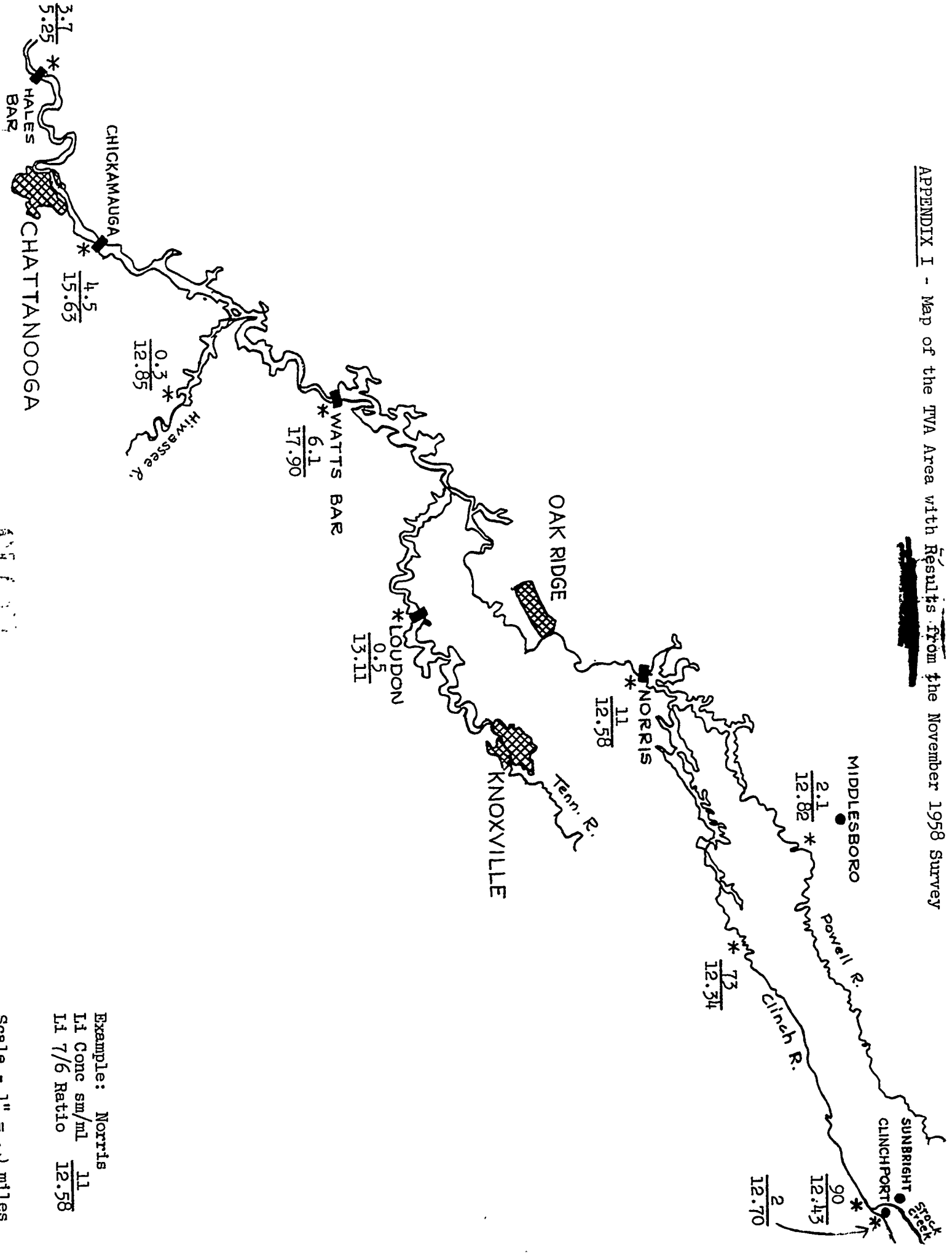
Sampling Site and Distance Downstream, Mi

FIGURE II. The Effect of the Y-12 Plant Effluent on the Isotopic Composition of Lithium



Sampling Site and Distance Downstream, Miles

APPENDIX I - Map of the TVA Area with Results from the November 1958 Survey



Example: Norris
 Li Conc sm/ml $\frac{11}{12.58}$
 Li 7/6 Ratio

Scale - 1" = 10 miles

APPENDIX II

Determination of Lithium in K-25 Plant Water

<u>Code</u>	<u>Date</u>	<u>Source</u>	<u>Li Conc. sm/ml.</u>
042	11-5-57	K-892 make-up from Clinch River	60
043		K-892-H Recycle	60
044		K-801-B make-up from Poplar Creek	11.5
059	11-15-57	Make-up, Clinch River	134
060		K-802-G Recycle	138
061		Make-up, Poplar Creek	78
064	11-20-57	Make-up, Clinch River	75
065		Recycle	80
066		Make-up, Poplar Creek	10
067	11-29-57	Make-up, Clinch River	65
068		Recycle	66
069		Make-up, Poplar Creek	20
075	12-5-57	Make-up, Clinch River	68
076		Recycle	74
077		Make-up, Poplar Creek	18
080	12-12-57	Make-up, Clinch (K-892)	67
081		Recycle K-892-H	68
082		Make-up, Poplar Creek (K-802)	13
083		Raw H ₂ O, Clinch (K-892)	15
084*	12-26-57	Make-up, K-892-H (K-33 treated)	21 *084 and
085		K-892-H Recycle	77 086 were
086		Raw Poplar Creek	63 probably
087		Raw Clinch River	20 mixed by sampler.
096	1-9-58	Treated make-up K-33	33
097		Recycle K-33	79
098		Raw Poplar Creek	190
099		Raw Clinch River	38
101	1-9-58	Recycle K-25	255
102		Recycle K-27	63
103		Recycle K-29	56
104		Recycle K-31	88
105	1-15-58	Treated make-up (K-33)	133
106		Recycle (K-33)	183
107		Raw Poplar Creek	290
108		Raw Clinch River	108

APPENDIX II (Continued)

Determination of Lithium in K-25 Plant Water

<u>Code</u>	<u>Date</u>	<u>Source</u>	<u>Li Conc. sm/ml.</u>
109	1-22-58	Treated make-up (K-33)	24
110		Recycle (K-33)	136
111		Raw Poplar Creek	512
112		Raw Clinch River	30
122	1-28-58	Treated make-up (K-33)	14
123		Recycle (K-33)	130
124		Raw Poplar Creek	138
125		Raw Clinch River	15

Remarks: The purpose of taking these samples was to get some ides of the amount of lithium being sent air-borne by the tremendous amount of H₂O evaporated daily at the K-25 Plant. The results were rather disappointing but did show a considerable amount of Li present in all the water.